INFLUENTIAL FACTORS IN SEAPORT INFRASTRUCTURE PRICING

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ABSTRACT

This study concentrates on the pricing of seaport infrastructure which includes port charges on the use of access channels and berth facilities. A closer examination of published port tariffs reveals that the port entry and berth use-related port tariffs, often referred to as channel dues and berth occupancy charges, are differentiated based on vessel volume (Gross Tonnage, Gross Registered Tonnage and Length Over All), ship type (container ship, general cargo ship, tanker) and traffic type (foreign-going vessels and coastal vessels). These two charges are one of the main revenue sources for a port authority; however knowledge of the design and imposition of these charges is currently opaque, but nevertheless very useful to port users. This thesis explores the determinants of port infrastructure charges that underpin port pricing policies in world ports. The main objectives of the study are:

(a) Identify and conduct an econometric analysis of the effect of various factors on seaport infrastructure charges.

(b) To assess the applicability of competing pricing models (pricing approaches) currently used by seaports in different countries and regions in the world.

(c) To assess the determinants of port infrastructure tariff design and practices in world seaports and discuss their implications for port management.

This thesis brings to notice that, despite the discussion on port pricing theories such as cost-based, market based and cost-benefit theories, the empirical research on this topic remains very limited. Thus, with identified research gaps such as the determination of the level of knowledge that port authorities have in tariff design and their applicability, the thesis investigates the underlying factors influential to the

design and practice of port infrastructure tariffs using both quantitative and qualitative research approaches.

First, the determinants of port infrastructure charges are studied empirically using data from 159 ports worldwide by employing the ordinary least square and simultaneous equation system method with channel dues and berth occupancy charges as the dependent variables. The result indicates that the pricing of seaport infrastructure is primarily cost-based but other factors are also relevant to the port pricing models currently used by seaports. Among those factors in particular, demand and the type of port management and governance model have been found to significantly impact the level of port infrastructure charges.

Second, to complement and triangulate some of the results found in the quantitative model, this thesis examines the primary data collected through an online survey of 67 international seaports to focus on the practical processes and strategic issues in infrastructure tariff design and practice. The questionnaire was sent to higher level seaport managers working in the areas of port tariffs. The contact details of port managers were obtained from the official port websites of respective port organisations. SPSS and AMOS statistical software were employed to analyse the data. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to identify the factors influential to the selection of infrastructure tariff models, the tariff level and the tariff revision process. The results showed that the influential factors in infrastructure tariff design are: a) demand, b) knowledge of pricing theories, c) pricing objectives, d) port cost considerations, and e) dynamics of port and shipping sectors (competition and ship size). Further, an analysis into the factors influential in infrastructure tariff practices of seaports suggested that tariff policies, transparency in tariff setting, tariff regulation and stakeholder participation in tariff affairs are highly significant.

Third, the content analysis of two open-ended questions included in the questionnaire to seaport authorities revealed that tariff revision practices vary substantially across ports and regions in the world. Some ports revise tariffs regularly while others seldom do so. Furthermore tariff revision procedures and the parties involved in the process also vary across ports; some ports have highly bureaucratic procedures for tariff revision and others determine their tariff revision decisions independently. Many seaport authorities are not aware of all the basic pricing approaches and their applications, and expressed a wish to receive training and support in tariff design and revision. Based on the results of the quantitative and qualitative analysis, the implications for port management and governments are discussed and, given the exploratory nature of the study, the implications for future research and its limitations are also presented.

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GLOSSARY

AC	:	Average Cost
ADB	:	Asian Development Bank
AFT	:	Annual Fee to Enter
ATENCO	:	Analysis of the main Trans-European Network ports' Cost structure
AVC	:	Average Variable Cost
BLT	:	Build, Lease, Transfer
BOO	:	Build, Own, Operate
BOT	:	Build, Operate, Transfer
BROT	:	Build, Rehabilitate, Operate, Transfer
CFA	:	Confirmatory Factor Analysis
CPV	:	Cost, Performance, Value
CS	:	Consumer Surplus
EFA	:	Exploratory Factor Analysis
EU	:	European Union
FDC	:	Fully Distributed Cost
GDP	:	Gross Domestic Product
GNP	:	Gross Domestic Product
GRT	:	Gross registered Tonnage
LAQ	:	Lease a Quay
LRAC	:	Long Run Average Cost
LRMC	:	Long Run Marginal Cost
LUP	:	shippers License to Use the Port
MC	:	Marginal Cost
MR	:	Marginal Revenue

NRT	:	Net Registered Tonnage
OCP	:	Operating Cost Pricing
RLT	:	Rehabilitate, Lease, Transfer
ROT	:	Rehabilitate, Operate, Transfer
SRMC	:	Short Run Marginal Cost
SW	:	Social Welfare
TEUs	:	Twenty foot Equivalent Units
TR	:	Total Revenue
TSC	:	Total Social Cost
UN	:	The United Nations
UNCTAD	:	The United Nations Conference on Trade and Development
UNESCAP	:	The United Nations Economic and Social Commission for Asia and Pacific

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CHAPTER 1 : INTRODUCTION

1.1 INTRODUCTION

This thesis develops a generalised framework, which will be used to analyse the determinants[1] of port infrastructure charges using the regression analysis method and influential[2] factors in tariff designing and practice using factor analysis. An extensive review of the current port pricing models is also conducted using an online survey of international ports. Policy recommendations are made for port managers and policy makers based on the results of an econometric analysis of secondary data collected from various sources and a factor analysis of primary data collected from the international port survey. This chapter provides a rationale for the research on seaport pricing including the background, objectives, research questions and hypothesis, the significance of the research and the methodological approach that will be used to analyse the factors influential to seaport infrastructure tariffs design, the tariff setting process and practices. Port infrastructure tariff "design" here means that setting up of port tariffs before implementation which includes the basis, level and composition of the charge. That may include parties participating, procedure, type of tariff, the basis of charge, discriminatory or not based on different parameters such as vessel size, traffic type and cargo type. Tariff practices are the ways that port authorities implement designed tariffs which may be affected by various other factors such as port users, regulators, transparency issues and port stakeholders.

1.2 RESEARCH BACKGROUND

Seaports or ports, be it the oldest ones in the world such as 'Byblos Port' in Lebanon or 'Lothal' in India[3], or the most up-to-date ones such as Singapore and Rotterdam, are critical to world trade as 80% of world trade by volume and 70% of world trade by value is transported by ships through ports (UNCTAD 2014). Thus the ultimate goal of all seaports throughout the world has been to provide efficient port services for vessels and to maintain the safe, reliable flow of cargo through the ports (Nagorski 1972). Seaports also play a critical role in regional trade systems allowing smooth interaction among economic and geographical units (Wang, Ng & Olivier 2004). An efficient seaport operation is therefore a prerequisite to maintain the global

[1] Determinants is a factor which decisively affects the nature or outcome of something, in that sense determinants of port infrastructure pricing in this thesis means, what has affected the level of port infrastructure charges to be different across world ports.

[2] Influential means having or exercising influence over something, in that sense influential factor are those factors which have influenced the designing and practice of port infrastructure tariffs.

[3] Byblos is considered to be the oldest city in the world (Krabbe 2001) and, according to recent excavations, Lothal appears to be a harbour city where seaborne trade may have originated (Prasad 1977).

competitiveness of the commodity market. In that sense sea ports, being nodal points in the global logistics chain, play a pivotal role in allowing international markets to function and integrate. Despite their critical role in national and global economies and trade, seaports are confronted with several challenges.

First, from the shipping industry's perspective markets, technological and structural changes have exposed seaports to intense competition. Increase in ship size, the formation of strategic shipping alliances, alteration of service schedules and restructuring in shipping networks and the need to utilise the port's full capacity have all reduced the contractual power of ports and terminal operators (Ferrari & Benacchio 2002), all of which have in turn resulted in fewer port calls. Intense competition among seaports is thus an inevitable market outcome as seaports strategize their planning process against each other in order to secure profit and increase market share. The increasing inter-port competition has produced a new dimension to the seaport industry. Further, transhipment hubs have been developed to respond to increasing vessel size.

Second, seaport congestion can seriously affect the service quality and performance of a port and the overall exporting and importing cost. To address the congestion issue a typical seaport either has the option of expanding its capacity by investing in additional berths and other superstructures or charging congestion levies to reduce the traffic to an optimal level. Although these strategies are theoretically sound and should generate expected outcomes, investment in capacity expansion (which can be costly) and charging a congestion levy are practicable only if ports have adequate capital to invest and a substantial market power within the port area or region.

Third, the above mentioned recent structural changes in the seaport industry, especially port ownership, form a new dimension in the seaport operation. Ownership structures have been subject to reforms after the 1980s in order to adjust to changing circumstances in the port sector. This was partly due to the belief in neoliberalism that restructuring would improve port performance and efficiency. In this regard devolution and the transfer of public assets to the private sector, public-private partnerships and concessionary agreements have influenced ports around the world to move from direct public management to autonomous, complex business entities with mixed forms of ownership and administrative models (Theys, Notteboom, Pallis & De Langen 2010). The core objective of reforming port ownership is to achieve a higher technical efficiency, economic benefits through competition, lowering bureaucracy and reducing public investments (Xiao, Ng & Fu 2010). Although port management is reformed, the private sector is allowed to participate in port activities only to a certain degree, operating beside public sector port institutions that maintain a higher degree of control over the overall port activities. Port development and reform in China is a clear example of this change whereby the terminal-level operation in ports is largely managed by a private operator, while the national-level port development and planning are entirely under the control of a public sector authority.

Last, as return on investment is the key criterion for assessing financial performance, port managements need to sustain the technical and operating efficiency of seaport infrastructure/superstructure facilities or to adopt advanced technological applications wherever possible. The financial position of seaports is also determined by the operating revenue that is conditional upon the level of seaport service operation, the price charged for seaport infrastructure and superstructure services, and the elasticity of demand for seaport services. Public port authorities often face capital inadequacy. In the absence of public subsidy, public port authorities are required to pay attention to the commercial viability of port operation and keep a close rein on any bureaucratic extravagancies that are commonly accepted as associated with public sector agencies (Dowd & Fleming 1994). The commercial viability of port operation is primarily determined by operating revenue from providing port services, which is fundamentally conditional upon the price charged for each port product. Thus a clearly articulated pricing strategy is a prerequisite to the success of a public port authority.

Contemporary seaports operate in a newly framed, globalised environment where combined transport, logistics, information flows and innovation, concentration and integration lead the market and each business in it. Within this framework seaports have become much more dynamic following the three principles of port development: European, Anglo Saxon and Asian. Until the late 1970s, the economic model based on Keynesian thinking, also known as the European view on port development, formed the basic idea for the ownership, infrastructure, investment, pricing policy and management of seaports. The fundamental thinking on seaport policy formulation and seaport development was the European view that followed the Keynesian approach of state intervention and national planning. The seaport development model was therefore based on state intervention. Public seaport authorities undertook investments mainly for regional economic development purposes by arriving at a criterion to determine seaport infrastructure pricing i.e. a model based on the marginal cost pricing principle, from which emerging deficits were fully financed by governmental subsidies. In the 1980s, Neoliberalism was adopted to liberate the sector and promote private ownership and participation in the sector. This was defined as the Anglo Saxon view and overset existing models, employing a new basis for the port production (Pardali 2008). As such ports models under Anglo Saxon view overlaid some of the established port models under European view and formed a new basis for port development and port privatisation schemes around the world is a vivid example of this change.

However the influence of seaport pricing and its policy on the operational objectives of seaports is understated. According to Dowd & Fleming (1994, p.31):

'Port's pricing approach should be supportive of the Port's overall objectives, be consistent with the Port's development and planning philosophy, and be a logical extension of the Port's investment criteria and policies'.

An analysis of port pricing policies and practices clearly demonstrated that, in the context of European Union (EU) ports, port financing and charging practices are substantially diversified (Haralambides, Verbeke, Musso & Benacchio 2001). The intricacy of disentangling issues in port pricing is not only associated with port management and operation, but also the macroeconomic context and the dynamic nature of the market structure within which seaports function. Many studies have so far focused on optimal pricing for transport infrastructure and services. Among these optimal pricing for seaport infrastructure and services still remains the most debatable area in port economics. In spite of the shift in economic philosophy concerning port development and operation, economic research has concentrated on port pricing, port capacity and evaluating investment policies that were undertaken (many of the studies on this topic date back to the 1960s). The changing view of port development and operation can be seen from the differences between early and recent studies on port pricing.

Although studies on port pricing dating back to the 1960s remain influential, port pricing practices that have been widely used recently are mainly propounded by three crucial policy documents. The first is by UNCTAD (1975) on 'port pricing' that aims to produce a level playing field for the public, private and foreign seaport entities in the world. The second is the European Commission's (1997) Green Paper on ports and maritime infrastructure operation and pricing in the EU context, and the third is the European Commission's (1998) White Paper that widens the horizon to include all transport infrastructures within the EU. Existing research on port pricing mainly concentrates on pricing policies and their impacts on maritime transport. While ports rely heavily on infrastructure charges as the main source of revenue and therefore port pricing as one of the main tools to help them achieve financial goals, little research has been done to study how ports set their tariffs and what factors are influential to their tariff design and practice. According to Meersman, Van De Voorde & Vanelslander (2002, p.2) 'pricing by ports and operators within ports is historically determined and it is often quite a complex and opaque matter, and as such is sometimes perceived as archaic'. Similarly, Strandenes & Marlow (2000) noted that 'there is no single solution to the port pricing problem'. While Heggie (1974) suggests that port pricing should reflect port costs including capital and operating costs, Ashar (2001) argues that a port's strategic environment should be considered when establishing port prices, including identifying the relevant market segment for the port, defining costs and performance indicators and estimating the comparative values for each market segment, and developing and assessing global pricing strategies. Further Perez-Labajos & Esteban Garcia (2000) showed that ports can set their tariff levels in order to maximise economic benefits and determine the efficient unit profit of the services offered and their sensitivity. Xiao, Ng & Fu (2010) explained the effects of the interdependence of port ownership, inter-port competition, capacity investment and port pricing.

The need for a sound port pricing theory has been thoroughly discussed in the literature (Ashar 2001; BTE 1989; Commission of the European Communities 1997; Dowd & Fleming 1994; ESCAP 2002; Haralambides 2002; Meersman, Van De Voorde & Vanelslander 2002; Meersman, Van De Voorde & Vanelslander 2003;

Perez-Labajos & Esteban Garcia 2000; Psaraftis 2005; UNCTAD 1975; UNCTAD 1995a), yet existing studies on the topic tend to be descriptive which are limited to view points based on observations and policy documents and many are also case studies that represent local or regional port[4] systems. The viewpoints and quantitative justifications discussed in these studies on port pricing are often inextricably mixed, and take a narrow view of the port pricing issue. More factors need to be considered when analysing port pricing. The determinants of port tariffs and the structure of port tariffs have not been given due consideration in port research while many researchers agree that 'research into pricing behaviour within ports certainly has some way to go' (Meersman, Van De Voorde & Vanelslander 2002, p.16). Moreover the boundaries of port pricing research are restricted to regional studies mainly concentrated in the European port region. The need to extend this boundary to encompass port pricing in seaports throughout the world is justified by this thesis. The framework for such a research study needs to be based on a multi-faceted perspective of the variables which affect the basis and level and composition of port charge (tariff design) and port pricing decisions (tariff practices).

1.3 THE OBJECTIVES AND THE SCOPE OF THE RESEARCH

This study primarily concentrates on the pricing of seaport infrastructure services including berth conservancy services and access channels. The main reason for this limited scope is threefold. First, seaport pricing can be based on the traditional public infrastructure pricing that does not consider the supply cost. Second, these charges are often universally applied to international seaports and are directly comparable unlike cargo handling charges and terminal charges which tend to be more market driven. Third, the debate on port pricing primarily concentrates on pricing port infrastructure and facilities. The most appropriate port tariffs for the utilisation of port infrastructure are channel dues and berth charges. For that reason in-depth quantitative and qualitative treatment is given to only to these two tariff items.

The fundamental aim of this thesis is to describe the determinants of port infrastructure charges that underpin port pricing policies in world ports. Several factors are pivotal when investigating a pricing policy for a particular product or a service from economic point of view. Tyndall (1951) postulates several factors which are of vital importance when analysing a pricing policy of a particular

[4] Regional ports in this thesis refer to ports situated in a specific port region.

industry. The first is the nature of the cost function for different amounts of products to a particular user, the structure and the number of consumers when the product per user is constant. Industries such as seaports involve large capital outlays, continuous maintenance costs and various overheads. Since capital costs are largely sunk and the pay-back period is relatively long, seaport authorities often try to consider the operating costs of seaports in their cost function. Additionally, seaports provide products which are jointly used by port users, thus allocation of user cost with an appropriate price over a series of port users is a difficult exercise.

The second is the nature of the demand function of different classes of consumers. Port users comprise different classes of vessels with specific cargo carrying purposes. The composition of port user clientele determines the type of demand for the port and its services, which in turn determines the revenue from each port user. Port authorities are required to properly consider the port clientele and strategise the pricing structure in accordance with the use of port infrastructure and services by different port users.

The third is the compliance of the existing price structure with the aforementioned factors. Seaport pricing policies in countries are seen to be characterised as policies that have significant differences in terms of the basis, regulation and management of charges. The pricing characteristics may be similar in some regions or have some differences depending on the specifications of the seaport's infrastructure, ownership, competition level, the nature of the port's clientele and trade flow and the geographical location of the port.

The aforementioned review of the relationship between port infrastructure pricing, and port development and competition highlights the importance in port pricing. The review also shows several salient challenges in efficient port infrastructure pricing despite extensive descriptive research already conducted so far on the topic. This study aims to investigate the port infrastructure tariff from economic and policy perspectives. In particular, it tries to achieve the following three objectives:

I. *Identify and conduct an econometric analysis of the effect of various factors on seaport infrastructure charges.*

Seaport pricing research so far largely concentrates on port pricing policy and principles, and gives little attention to the nature of seaport infrastructure and seaport infrastructure charges. Thus an econometric analysis of port charges considering the relationship with the costs arising from infrastructure investment, maintenance, port demand, operation and port management, and institutional set up is essential to the understanding of port infrastructure pricing. Such an analysis will also consider the effect of other factors such as the ownership and administrative structure of ports. Thus, the analysis would determine whether and how various factors such as port ownership, administrative structure, port demand and location may affect the tariff level. This study uses secondary data from seaports of different types in different countries and regions in the world to analyse port infrastructure charges using the simultaneous equations regression method in order to help identify the key determinants of seaport infrastructure charges.

II. Assess the applicability of competing pricing models (pricing approaches) currently used by seaports in different countries and regions in the world.

There are many pricing models currently referred to by economists and used by ports, and it is important to investigate the applicability of these models. This study investigates the applicability of port pricing models through a survey of international ports. An online survey instrument is employed to collect data and information on the pricing models currently used by ports and their knowledge of other pricing models and their applicability. Standard methods of sampling are applied to minimise systematic and non-systematic data collection errors. A trial run of the questionnaire is conducted before the formal survey is undertaken. To achieve the above mentioned objective, data are coded, pre-processed and analysed using univariate and multivariate statistical methods.

III. Assess the determinants of port infrastructure tariff design and practices in world seaports and discuss the implications for port management and policy makers.

It is expected that the results of the analyses described in the previous objectives will shed light on the functionality and applicability of the existing port pricing models. Therefore the third objective of this research is to apply those results to the port industry given its distinctive characteristics regarding ownership, administrative structures, inter-competition and demand, objectives and institutional features (such as the level of knowledge of port authorities, transparency, stakeholder participation in tariff setting and tariff revision mechanism). To this end, an online survey of port managers is conducted to canvass their views on the aforementioned factors. The data collected from the survey is analysed to reveal the level of knowledge of ports and infrastructure pricing approaches presently used and current tariff revision practices and considerations. It is hoped that the study will not only help to achieve a better understanding of port infrastructure pricing but also translate this into actions available to the port industry to assist with the achievement of the broader social and economic goals of their national economies.

Scholarly contributions on port infrastructure pricing in world port industry context are rather limited. More importantly there is a lack of identification of factors influential to infrastructure tariff design and tariff practices. This extensive study on port infrastructure pricing examines how tariff designing and tariff practices are affected by various factors including the ownership structure and institutional arrangement, competition element, regulation, port users and furnishes this limitation. In doing so it helps to formulate a basis for seaport infrastructure pricing, for both tariff design and practices, based on the above factors. This also helps to identify issues in port infrastructure pricing policy by reviewing the basis for infrastructure pricing adopted by international ports. It is also expected that individual ports are able to review their port infrastructure pricing regime against the significant determinants of port infrastructure tariffs found in this study.

1.4 RESEARCH QUESTIONS AND HYPOTHESES

As mentioned earlier, the first objective of the research conducted in the current and subsequent chapters is to assess the knowledge and applicability of competing infrastructure pricing models held by international seaport managers. Despite the fact that, as noted by Haralambides et al. (2001), there is a lack of knowledge and information regarding port infrastructure pricing, there has been little empirical research into the existing knowledge of seaport managers about port infrastructure pricing principles, and the extent to which they are applied in tariff design. Given the many existing pricing models currently referred to by existing port pricing studies, it is of paramount importance to investigate their applicability. This study, using primary data collected from the survey with the participation of seaport managers, assesses the existing level of knowledge held by port organisations of port pricing theories and approaches, and inquires into the extent of the use of this existing knowledge within the port organisation when formulating and designing port infrastructure tariffs for their respective seaports. In order to achieve the first research objective mentioned above, the following three research questions are proposed.

Research Question 1: What is the level of applicability of pricing approaches in the development of the port infrastructure pricing models?

The main debate concerning port infrastructure pricing is centred on the need for port infrastructure tariffs to be cost-based. However, formulating cost-based tariffs depends on the extent to which port authorities compile and account for port costs, in turn, the occurrence of such an exercise is conditional upon the level of knowledge and technical competencies of the port management. The level of knowledge that port authorities possess concerning port pricing theory determines the extent of their ability to adapt these theories in practice. Thus, it is imperative to understand, from the perspective of the port authority, the awareness and the level of knowledge held by port management about port pricing theory and principles. In addition, to complement the aforementioned, it is also important to understand the extent to which port pricing theory and principles are presently used in order to verify past research findings, such as Notteboom & Winkelmans (2001, p.82) who state, *'most* port authorities are maintaining remarkably arbitrary tariff structures, based on discrimination by demand factors rather than on anything to do with costs'.

Thus, the primary data analysis investigates the knowledge and the applicability of port pricing principles and their use in practice by testing for the following *Research Hypotheses (RH)*:

RH1: Seaport authorities possess substantial knowledge on port pricing theory and principles.

RH2: Seaport authorities to a larger extent apply port pricing principles in port infrastructure tariff design.

RH3: Seaport authorities often attempt to formulate efficient cost based port infrastructure tariff design.

RH4: The majority of seaport authorities follow a structured procedure for port infrastructure tariff design and revision.

The second objective of the research presented in this and subsequent chapters is to identify the key factors influential to the determination of infrastructure tariff design (the process and practice). To achieve the second research objective, a conceptual framework is constructed to assist the development of a questionnaire for a survey of international seaport managers. The data collected from the survey are then analysed to identify the extent to which the port institutional setup, demand, infrastructure financing, policy and wider industry-related factors such as competition and vessel technology, influence port infrastructure tariff determination. As shown in the literature review in Chapter 2, the port pricing literature so far largely concentrates on port pricing policy and principles. In the determination of port infrastructure tariffs little attention has been given to the nature of port infrastructure management, its institutional set up, the influence of port infrastructure users, the port's competitive environment and the spatial distribution of ports. Thus, it is essential to understand the factors influential to port infrastructure tariff design from the perspective of the seaport organisation. This also complements and helps to validate the results of the secondary data analysis of port infrastructure tariffs presented in Chapter 3 on the determination of the level of port infrastructure tariffs. This research objective is achieved by addressing the following *Research Question (RQ) II* with the support of one research hypothesis:

Research Question 2: What are the factors influential to port infrastructure tariff design?

The determination of port infrastructure tariff design and its influential factors have, to date, not been given much consideration in port research. Furthermore, this has to be understood in a wider context with an investigation based on ports from different regions of the world. In the light of the knowledge held by port authorities of port pricing theory and the extent to which this is applied in pricing port infrastructure, the internal and external factors that affect port infrastructure pricing are investigated. This enables an understanding of the determinants of port infrastructure pricing within a broader context. The fundamental question that the research attempts to answer is how port infrastructure pricing designs are determined. In this respect the extent to which the cost of providing port infrastructure, port demand, port governance structure, port competition, port finance level, government policy and shipping market dynamics play in determining port infrastructure tariffs design needs to be examined. In order to address this research question the following hypothesis is tested:

RH5: Port infrastructure tariff design is influenced by the port's organisational objective, costs, financial position, demand related aspects, competition and government policy and regulation.

The third objective of the primary data research is to identify key factors affecting port infrastructure tariff practices. It is expected that the results of the analysis obtained from the previous steps will shed light on the applicability and functionality of various port pricing models and factors influential to its tariff design. Therefore the next step in this research is to apply those results to international ports in general given the sector's distinctive characteristics regarding ownership and financial structure, institutional arrangement, market competition, the economic role of ports and their relationships with other sectors. A content analysis of the results of the questionnaire is conducted to examine various aspects of port infrastructure tariff practices including the differences and inconsistencies in port infrastructure tariff policies, the level of transparency, the level of stakeholder participation in tariff affairs, tariff discrimination and the revision of port infrastructure tariffs. This analysis should contribute to a better understanding of port infrastructure pricing practices and also provide a framework for ports to achieve their broader social and economic goals.

Research Question 3: What are the factors affecting port infrastructure tariff practices?

Port charging practices have been found to vary substantially and to have diverse effects on port operations (Bennathan & Walters 1979; Psaraftis 2007; Wilmsmeier 2007; Zachcial, Kramer, Lemper & Duhme 2006). The underlying factors responsible for such varied charging practices have not been empirically identified, although there are some analyses purely based on intuitive judgements. Thus, the following hypotheses are tested to help answer the third research question:

RH6: Port infrastructure tariff practices are influenced by port stakeholders, the level of transparency, port autonomy, regulatory regime, port user behaviour and the competitive environment that the port operates in.

RH7: The differences in the ownership structure and the administrative structure have significant influence on port infrastructure tariff practices.

The three research questions presented above derive from two research gaps identified in the existing port pricing literature. The first is the lack of an empirical assessment of the extent that port pricing principles and port pricing practices are converged. The second research gap is in identifying the determinants of the port infrastructure pricing models that are presently applied by seaports and the factors that affect the port infrastructure tariff practices of seaports. This study conducts an empirical investigation of port infrastructure tariffs, and so addresses these two research gaps, and contributes to the existing body of knowledge on port pricing.

1.5 SIGNIFICANCE AND CONTRIBUTIONS OF THE RESEARCH

Academic research on seaports often concentrates on a specific area of port management and operation. Studies on port pricing so far are primarily characterised by more conceptual studies on pricing models based on microeconomic principles. In Pallis, Vitsounis, De Langen & Notteboom (2011), port pricing research is classified as 'port policy and regulation' research with often descriptive research and a limited empirical analysis, while in Woo, Pettit & Kwak (2010) it is classified as 'port management and strategy' research. According to Xiao, Ng & Fu (2010), there has been limited quantitative empirical research on the topic that is based on a sound and valid methodological framework. Thus, this study seeks to address this issue in the literature by developing an analytical framework that can be used to analyse port infrastructure pricing. It also studies the port infrastructure tariff design process and practices used by international seaports and based on the results of analysis may provide recommendations for port management and policy makers.

Contributions to port authorities, users and regulators:

Port infrastructure is fundamental to the smooth operation of ports and the mobility of cargo and passenger vessels. The resulting efficient operation of port services guarantees the proper operation of the internal markets that ports serve. For port infrastructure to be operated efficiently the continuous maintenance and upgrading according to the requirements of the shipping industry is a pre-requisite and the extent to which port authorities are able to achieve this goal depends on their financial capacity. The financial position of the port entirely depends on the port pricing policy adopted by the port organisation. Thus pricing policy formulated by the port is decisive in offering the most desirable price for port users. According to Tyndall (1951, pp. 342),

> '*The increasing role of government both in actual production and in the regulation of industry makes it increasingly important that the public administrator have a clear concept of the most desirable price structure and the role of the price theorist in this area is to provide the administrator with a theoretical framework for attacking this problem*'.

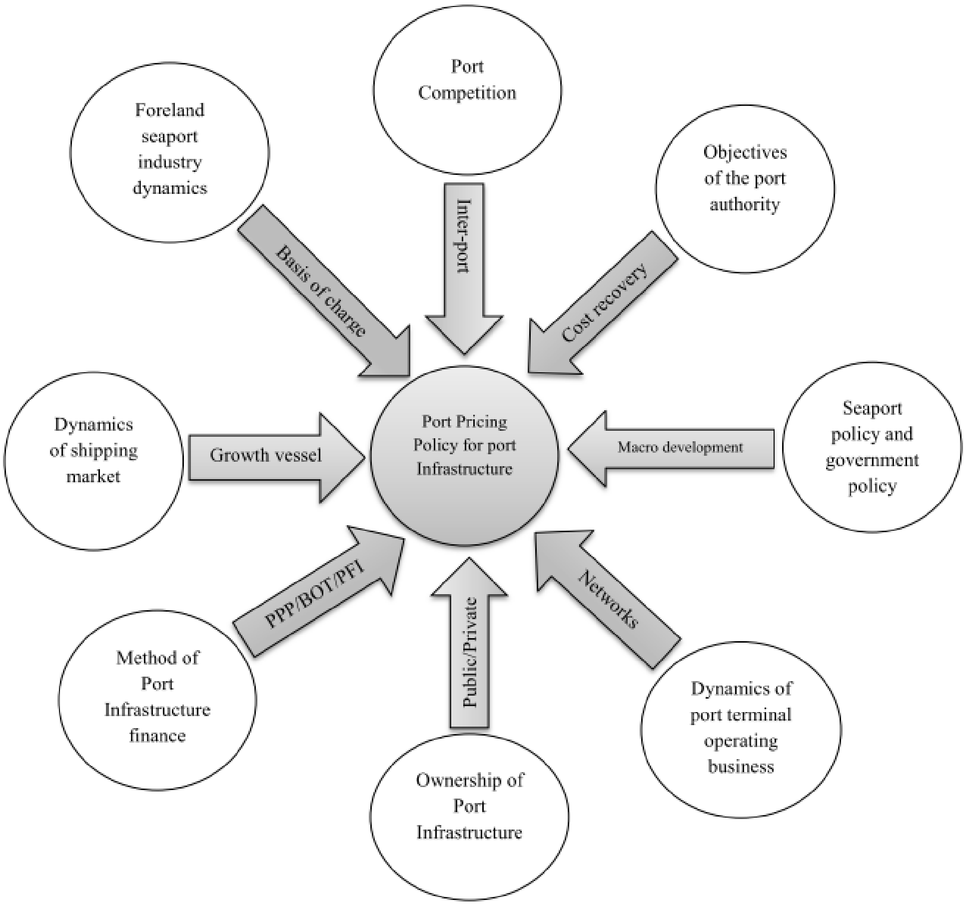
As such, seaport infrastructure pricing has long been the policy topic in organisations responsible for smooth functioning and the management of maritime transport. The policy directives of UNCTAD on port pricing and the EU on fair competition in maritime transport within Europe are the most popular examples in this regard. It has been agreed that there is a need for improvement in seaport infrastructure pricing. Therefore, developing a framework for infrastructure tariff structure for seaports is a timely important and significant exercise given the incredibly mixed nature of policy directives on the subject. The methodology proposed by the study allows for an analysis of the effect of various factors on port infrastructure tariffs.

1.6 PROPOSED CONCEPTUAL FRAMEWORK AND METHODOLOGY

1.6.1 PORT PRICING FROM A MULTI-FACETED VIEW

Seaports are similar to firms offering multi-products; a range of port services are provided to port users under different institutional and management structures, competitive environments and geographical locations (Wilmsmeier 2012). Thus port prices in general can be influenced by the same factors which may be internal or external to the port. Within the port jurisdiction the port cost situation, port governance and the seaport policy pursued impacts on the way the port sets prices for its infrastructure and services. Beyond the port’s control perimeter, the market environment within which the port operates (which includes the port market, geographical location and shipping market) exerts some influence on the port’s pricing decisions. The Figure 1.1 summarises the key factors influential to port pricing policy that are explained below.

Figure 1.1: A multi-faceted view of port infrastructure pricing.



Source: Developed by the author.

Impact of port competition, dynamics of foreland seaport industry and port terminal operation on port infrastructure pricing

Similar to other sectors, the port sector is exposed to competition. The level of competition in the port sector is primarily determined by characteristics such as the geographical location of the port, the number of ports in the region under consideration and the extent to which port hinterlands are overlapped, the nature of the shipping market each port serves and the level of regulation of port activities by the government. Competition may also exist within a port that has more than one terminal operated by different operators, often private companies. Within ports, occupation of terminals by two or more private sector terminal operators has produced intra-port competition for capturing port traffic. As discussed earlier, the formation of a network of terminal operators within port foreland areas and regions has created a new form of port market in which port authorities can respond by reforming tariff policies. These terminal operators strategically occupy port terminals in a port area and operate within a system of hub and spoke so as to guarantee that their facilities are fully utilised. The simultaneous occupation of terminals in feeder ports and hub ports secures the operators cargo handling business while the respective seaports receive adequate vessel traffic.

Dynamism of the shipping industry

The dynamics of the global logistics networks and the international nature of shipping operations have subsumed seaports in terms of their significance, role and institutional arrangements. Nevertheless seaports often strive to establish their position and identity in the global logistic chain by incorporating 'corporate governance' within the port jurisdiction. Also seaports around the world endeavour to establish efficient and cost effective port services in the face of expanding international trade. In this regard, seaport authorities have begun to reshape the organisational setup of seaports. For instance major seaports in India have considered a series of reforms in order to establish flexible organisational models ranging from the existing port authority system to a more corporatised model with corporate governance (WTO 2001).

In the presence of mergers and acquisition among shipping lines, inter-port competition and the desire of seaports to increase port efficiency, an integrated package of lower port charges along with new value-added services for vessels and adequate port infrastructure is vital if a seaport wishes to gain competitive advantage over its rivals. The increasing influence of global shipping alliances on seaports has also resulted in the declining dominance of ports in the maritime network and most ports can no longer be considered as monopolists. It is important for a seaport to account for the factors that affect the competitiveness of the port from the perspective of the shipping lines. The port selection decision taken by a shipping line can greatly affect the performance of a port in both operational and financial terms. Tongzon & Sawant (2007) claim that port charges and the efficiency of port services are among the important factors influencing port selection by shipping lines. Fung (2001) revealed that the prices ports charge to shipping lines and the extent to which they facilitate the requirements of shipping lines are functionally related to the market share of ports serving overlapping port markets. This implies that port tariff structure has a significant impact on the port costs of shipping lines, and port authorities need to be aware of the impact of their charges on shipping companies especially when they are revising their tariffs and setting tariffs for new services.

Cost recovery in port infrastructure investments

According to Braeutigam (1980) a port should set its tariffs based on the costs of running the port as well as its characteristics, e.g. economies of scale and the presence of joint and common costs. Since the use of port infrastructure demonstrates lowering unit cost of production with time, port charge can be set to represent fall in average cost of infrastructure. Further, since maintenance costs of some port infrastructure are joint/common, for instance, deepening channel and berth alongside, the setting port channel dues and berth occupancy charge need to consider these two cost as common and the charge need to reflect it. Financing port infrastructure with public funds is rationalised on the basis that port development generates macroeconomic effects on the economy from which tax payers are indirectly benefited. However the need to recover the cost of port operation is at the forefront of the port authorities especially if the construction of port infrastructure has been financed from loan facilities. The influence of these two scenarios on determining port charges is a matter of concern for a port authority.

The methodological frame work presented in this study considers only certain aspects of the above multi-faceted view of port infrastructure pricing. These aspects are referred to as determinants of port infrastructure pricing. The next section briefly presents the methodology adopted in the study.

1.6.2 METHODOLOGICAL FRAMEWORK

There are three aspects to the methodological framework to be adopted by this study. First is the need to understand the present port infrastructure pricing policy and related issues; the study takes into consideration the nature of infrastructure pricing policy and related practices and issues. This will be undertaken from the information gathered from an extensive literature review on port pricing, which will be presented in Chapter 2.

Second, the study develops a quantitative framework from which the relationship of port infrastructure charges to port costs, port demand, the administrative structure, trade flow and the port area or region are estimated. To achieve this objective, the study develops an econometric model explaining the relationship between port infrastructure tariffs and the key influential factors such as ownership structure, port infrastructure specifications and prices of infrastructure related services. The econometric analysis is carried out using an equation system for two main types of port infrastructure tariffs, namely berth due and channel due as the dependent variables, and the data are collected from 159 major ports.

Third, the study also attempts to examine how port infrastructure tariff design is influenced by the port management's knowledge of the issue and applicability of port pricing approaches, cost recovery consideration, port demand, port tariff objectives, inter-competition and shipping market dynamics. In addition, the study seeks to analyse the key factors influential to port infrastructure tariff practices such as the level of transparency, stakeholder participation in tariff setting, tariff regulatory control and a port's tariff policy. The analysis is carried out using data gathered from an online survey of 67 international seaports across different regions. Both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) methods are used to aid the analysis. The conceptual framework, data analysis and results, and the discussion are presented in Chapters 4, 5 and 6 respectively.

1.7 DATA AND INFORMATION COLLECTION

Data and information on port tariffs is usually published annually by more established seaports. In order to analyse the present tariff structures operating in contemporary seaports, the published tariff structures of 159 major ports in the world, including top performing container ports have been collected from various official data domains including the respective web sites of each ports, the *Ports and terminals Guide*, a publication by Lloyd's Register Fair Play Ltd (2011). The types of data required for collection for this econometric analysis are presented in the Table 1.1 below.

Table 1.1: Data requirements for econometric estimation.

Channel related data	Berth related data	Port demand data	General port data
Channel dues Channel length Channel depth Channel width	Berth dues Berth length	Trade flow	Port ownership Port administrative model

Source: Author's compilation.

For the analysis of factors influential to port infrastructure tariff design and practices a structured questionnaire was sent as an online survey to 450 world seaports representing major port regions. A detailed explanation of sample selection and questionnaire design is presented in Chapter 4.

1.8 THE ORGANISATION OF THE THESIS

The thesis is organised as follows:

Chapter 2 presents a comprehensive review of the existing literature on seaport pricing, especially that of port infrastructure. This includes the main port pricing principles; a review of the literature related to port pricing process, policy and practices will also be covered in Chapter 5.

Chapter 3 elaborates on the conceptual and methodological framework introduced in Chapter 1 and presents an econometric analysis of the relationship between port infrastructure charges i.e. channel dues and berth dues to port costs (using infrastructure specifications as proxies), port ownership, port administrative structure, port demand and port region.

Chapter 4 presents the methodological approach in which the objectives, research hypothesis, conceptual framework, questionnaire design, sample selection and data collection are explained.

Chapter 5 explains the data analysis process and presents the analysis results. In this chapter the survey data are analysed using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).

Chapter 6 is primarily devoted to a discussion of the results and their implications. Firstly, the results presented in Chapter 4 on factors influential to infrastructure tariff design and practices are discussed. Then a comparative analysis is presented of the results obtained from the econometric estimation of port infrastructure charges in Chapter 3, and the results derived from the EFA and CFA concerning the factors affecting port infrastructure tariffs obtained in Chapter 5. Lastly, the implications of the research findings on port management are discussed and some directives for port management are provided in terms of port infrastructure tariffs.

Chapter 7 discusses the limitations of the study, the implications for future research and provides a summary of the study.

CHAPTER 2 : LITERATURE REVIEW

2.1 INTRODUCTION

The growth of international trade followed by the growth of the shipping sector has resulted in a rapid pace of development and a higher level of competition in the port sector. Ports have also improved service quality with the adaptation of latest information technology (IT) and cargo handling technology. To contend with these changes it is important that ports have pricing strategies that are able to cope with the dynamism of international trade and commodity flows. Further a greater consensus and concern among ports regarding the restructuring of port pricing strategies to include justifiable port investment and cost recovery considerations has developed in major port regions of the world (Juhel 2001).

A recent policy level initiative concerning this matter is the European Commission's proposition on adopting a common approach to pricing port infrastructure in order to ensure that the real costs of port services are borne by port users (Abbes 2007). Following this initiative, seaport infrastructure pricing and its dynamic nature were subjected to extensive research from technical and policy perspectives. However, there are different views concerning the approach that a port infrastructure pricing system should take. The European Union's Green Paper (European Commission 1997) identified three approaches to port infrastructure charges with regard to cost-based pricing: *marginal cost pricing*, *average cost pricing* and *charging for operating cost recovery*. The classification was further extended by Strandenes & Marlow (2000) as *cost-based pricing*, *congestion pricing*, *strategic pricing* and, with the incorporation another version of the pricing principle, *commercial pricing* which could be applied to private port operators. However Abbes (2007) classified port pricing into two major categories.

1. **Cost-based pricing strategies** such as*: marginal cost pricing* (Bennathan & Walters 1979; Goss & Stevens 2001; Haralambides 2002; UNCTAD 1975), *operating cost pricing* principles (ESCAP 2002) and *multi-part tariffs* (Bennathan & Walters 1979).
2. **Alternative pricing strategies** such as: *strategic pricing* (Ashar 2001; Bennathan & Walters 1979; UNCTAD 1995a), discriminatory pricing (Bennathan & Walters 1979) and *commercial pricing* (Strandenes & Marlow 2000).

Bichou (2009) divides port pricing strategies into three groups, namely *cost-based pricing*, *congestion pricing* and *strategic pricing*.

Although there are several types of port pricing strategies, they are derived from the same economic principles, particularly the principle that prices should be set based on market forces, competition and other relevant factors affecting the environment in which the port operates. For example, prices can be set to maximise profit or the users' welfare. Alternatively, to ensure the port's financial sustainability, prices can be set to ensure that revenue covers at least the cost of providing services, including capital expenditure and operational costs (Bennathan & Walters 1979). Note that this, in principle, requires that a minimum, break-even capacity utilisation rate is met.

To maximise economic and social benefits, the port would need to identify and promote the movement of specific commodities that are strategically important to the economy or region it serves. In this context the port functions as an economic multiplier to promote production, distribution and consumption through which favourable economic growth and development is expected to be achieved (Coto-Millán, Mateo-Mantecón & Castro 2010; Coto-Millán, Pesquera & Galán 2010a; Coto-Millán, Pesquera & Galán 2010b). Note that where prices are set solely for the purpose of recovering the supply costs i.e. the operating cost of the port services, they may be adjusted on an arbitrary basis, and thus may not be aligned with the port's objective of ensuring competitive operation.

This chapter presents an evaluation of the literature on port pricing, particularly research on port pricing approaches and their application. Section 2.2 reviews port pricing in world context. Section 2.3 elaborates on the nature of port infrastructure charges. Section 2.4 reviews the cost-based port pricing strategies including marginal cost pricing, average cost pricing, average variable cost pricing, congestion pricing, multipart tariffs and cost of service pricing. Section 2.5 reviews alternative pricing strategies including strategic pricing, input and output pricing, discriminatory pricing and commercial pricing. Section 2.6 reviews the literature available on cost based pricing and alternative pricing strategies as represented by strategic port pricing, input pricing, value of services pricing and commercial pricing. The objective of the review is to determine which pricing approaches are suitable for an empirical investigation. The investigation is presented later in this thesis.

2.2 PORT PRICING IN A WORLD CONTEXT

Pricing is one of the key decisions facing economic agents as it directly and greatly affects two key aspects of business, namely profitability and competition. Generally several factors can affect the pricing of a product or a service in commodity markets, including: market demand, competition (market structure), availability of substitutes, corporate strategy, the quality of the product or service, production costs and the policy. While these factors should in general apply to the port sector, the extent of the effect of each factor on port pricing will vary because of the strategic nature of the seaport industry and the nature of port costs; port operation is capital intensive and capital investment is highly irreversible. Moreover, as ports are often regarded as public assets their funding depends on public finance. However, due to the availability of capital market directives and the financial support of international monetary and development agencies, private sector participation in seaport operation has been the novel trend over the last decade. The role of the government in the provision of seaport infrastructure has been limited to official delegations and the signing of agreements for seaport infrastructure projects that feature public and private partnerships. Public and private partnerships now play a greater role in large scale infrastructure projects especially in the transport sector. In these circumstances there is often a contradiction between public socio-economic objectives and private financial objectives, with tariff policy one of the main conflicting issues (Boeuf 2003). This, together with increasing demand and competition on the sector, has led to extensive changes in the sector and in the way in which port services are priced.

Following the aforementioned changes, the institutional position of seaports in the world has entered a far-reaching reform period (Peters 2001) that, according to Wang, Ng & Olivier (2004), has three significant features. First, seaports are now required to provide more standardised port services to facilitate production units in the global supply chain. Countries need to strategize their transport policies and infrastructure to meet the requirements of not only domestic demand but also the increasing demand for transhipment of cargo. Containerisation which revolutionised the nature of maritime freight transportation caused a substantial degree of standardisation of port services in order to be competitive over adjacent container handling ports (OECD 2009).

Second, the emergence of multinational port terminal operators has created pressure for ports to adapt to the changing business environment. Since the strategic behaviour of shipping alliances determines which port or port terminal to call, terminal operators are significantly affected if one alliance is in operation in a particular maritime corridor. The ultimate survival plan for terminals is to confront each other by way of a price war which features oligopolistic behaviour between terminals and it is achieved by lowering tariffs (Heaver, Meersman, Moglia & Van De Voorde 2000). Strategic behaviour of liners has resulted in competition between ports and within ports that have multiple terminals. A recent research study by Drewry Shipping consultants (2002) shows that the tariff diversification among a range of ports is highly significant.

Table 2.1: Tariff Diversification among different regions in the world ($/TEU).

Region	Gateway (ship's hold to stack to track or vice versa)	Transhipment (tariff per cycle)
North America	312	130
North Europe	120	152
South Europe	113	76
Far East	164	163
South East Asia	92	104
Middle East	106	85
Latin America	174	201
Australasia/Oceania	130	196
South Asia	106	85
Africa	256	99
East Europe	144	183
South East Asia	113	76

Source: Adopted from Drewry Shipping Consultants (2002) and Ferrari & Benacchio (2002)

As shown in Table 2.1 there is a significant diversification of port terminal tariffs worldwide. This implies the varying degree of competition between ports across different regions in the world (Ferrari & Benacchio 2002) and the resulting tariffs being the result of the market forces of demand and supply, competition and institutional factors. To be competitive, ports should be able to handle any additional vessels calling at the port and the ability to do so is a direct function of the port capacity and its cargo handling efficiency. Thus, apart from terminal-level cargo handling charges, terminal operators can have significant impact on the port infrastructure charges and their levels as they are deterministic in total shipping costs.

Third, seaports often attempt to restructure their position as value-adders to the global logistics chain by increasing their efficiency and productivity such that the dwell time of cargo and ship turn-around times have substantially improved. Sectoral reform necessarily involves modifying port governance frameworks in order to promote the ability of the port management to increase the economic viability of the port operation independently. One of the basic adjustments is the separation of capital investment on ports from state finances and establishing the self-responsibility of port management for profits and losses (Sun, Wu & Skeel 2010). Various forms of state aid provided to seaports by EU member states was primarily aimed at restructuring ports and port facilities and strengthening against contemporary challenges (Pallis & Tsiotsis 2007).

On the other hand, seaports in developed and developing countries have been passing through several stages of structural change, yet some specific features of seaports in general are inextricably mixed. For instance many seaports are still owned and operated by governments or statutory bodies of governments. Ports in the USA are 'landlord ports' mainly functioning as 'public enterprise' under the port administration of public sector port authorities (ADB 2000; Fleming & Baird 1999; Guan, Yahalom & Sha 2010). Many ports in Western Europe feature similar structures. In developing countries, port operation has shown some degree of restructuring but the port sector has been relatively lagging behind more industrialised counterparts such as Singapore, Port Klang and Dubai. On the contrary the emergence of private ports has been a result of port restructuring in many developed nations such as the UK, Australia and New Zealand. Private port entities emerged in the UK, including all 23 ports owned by Associated British Ports, as well as the ports of Liverpool, Manchester and Felixstow (Cullinane & Song 2002). The port of Felixstow shows a major structural shift in the UK transport policy directives in terms of transferring ownership from public to private (Baird 1999) and, as an example in a developing country, the port of Ambarli in Turkey underwent a similar process (Birsel & Cerit 2010). Similarly some of the major ports in Australia and all the major ports in New Zealand have been transferred to private sector (Everett 2009; Tull & Reveley 2001). Furthermore about 55.3 % of seaport entities in the EU are private sector companies which suggests the states' withdrawal of investment in port infrastructure and services (Paixao Casaca, Carvalho

& Oliveira 2010). In the world scale, seaports in over 50 countries were privatised between 1991 and 1998 (Ashar 2001).

The aforementioned facts, inferences and figures suggest that port governance and port operation has become more dynamic in nature with private sector participation and in response established ports, emerging ports, and new ports are required to be equipped with the appropriate and necessary apparatuses to face market challenges. One of the most debatable topics in this regard is the seaport pricing policy for port infrastructure services. Given the institutional changes within the seaport sector with private sector participation in terminal operation and other cargo related seaport services, how a port policy addresses the pricing issues of seaport infrastructure remains unsolved to date.

As mentioned earlier many port regions are affected by the Anglo Saxon and European views and do not have an appropriate seaport pricing policy. One of the best examples of this is the debate about whether a pricing policy reflects the true cost of providing port services in European port industry. The pricing policy is expected to be capable of establishing fair competition in the seaport industry in the European Union. This also raises the question whether contemporary seaports have been engaged in unfair competition. Undertaking research to consider seaport pricing along with port demand, competition, ownership and administrative structure, cost and financing and the tariff objectives will provide a new insight in to the seaport pricing policy formulation which aims to establish fair seaport competition. Moreover an investigation into the existing level of pricing knowledge of port authorities and its applicability in tariff design and other factors influential to tariff practices such as tariff policy, transparency, stakeholder participation and regulatory control over tariff will also provide new insights in to the sea port pricing practices.

In contemporary seaports there is a clear distinction of roles, ownership and operation which exist mainly in the vertical direction of the seaport value chain, while players in the total logistics chain tend to be vertically integrated. Table 2.2 demonstrates ownership and operational status in term of public and private sectors.

Table 2.2: Ownership and the Operational structure of Seaports.

		Ownership	Operation
Infrastructure			
	Navigation aids	G	G
	Access channel	G	G
	Port basin	G	G
	Berths	G	G/P
	Terminals	G	G/P
Superstructure			
	Cargo handling machinery	G/P	G/P
Port Services			
	Stevedoring	G/P	G/P
	Pilotage	G/P	G/P
	Towage	G/P	G/P
	Mooring	G/P	G/P

G= Public sector P= Private sector

Source: Created by author

According to Table 2.2 the ownership of port infrastructure is clearly under the public sector (government) and often a port authority representing the government has the jurisdictional powers on the ownership. The most accepted neoclassical view is that port infrastructure is financed through government funds which are often from taxpayers' money. Therefore the cost of the provision of infrastructure does not need to be recovered for the reason that ports benefit the economy by way of facilitating international trade, generating employment directly and indirectly, and thereby generating regional development impacts. Nevertheless the question is what happens if port infrastructure is financed through long term credit facilities from international financial agencies and the developed infrastructure are hosted by private sector operators? These loans are paid by the government using the foreign exchange earnings of exporters and other foreign exchange sources. Should the burden of loan repayment be passed onto the group of consumers who indirectly benefit from the port service, or onto the direct users of the port services whose objective for consuming port services entails setting profit maximising prices for the services offered to cargo owners at ports?. This remains debatable. As the pricing is the most strategic element of the seaport policy the pricing of port infrastructure and related services requires a comprehensive multi-faceted approach that deviates from the customary research approach that often deals with the pricing of seaport infrastructure at discrete within the port sector research.

The degree of involvement of public authorities in port service provision largely depends on the seaport policy used (Verhoeff 1981). The degree of involvement is considerably higher in countries where seaports and port services are considered as national assets and lower for some countries where port activities are considered to be economic activities with adequate returns on investment made on infrastructure and superstructure. The degree of public sector involvement also depends upon many other aspects of the institutional set-up of the port. Among these, corporate governance, commercialising port business, standardising procedures and reforming tariff policy to be on a par with the demands and the requirements of the commercial shipping industry are critical areas of concern.

Tariff structures of seaport infrastructure in ports have traditionally been formulated and implemented with certain changes from time to time. The tariff structure for ports can be analysed from three perspectives. The first is derived from the basis of tariffs. The commonly accepted basis is gross tonnage of vessels (GT) or net tonnage of vessels (NT). During the course of time ship technology has changed as has the size of ships, with an obvious great influence on the tonnage of ships. Thus the question is: to what extent does the tariff structure represent the variability of the size of the ships in terms of gross tonnage and also the variability of the change in the tonnage classes of vessels over a time?.

The second is based on the management of the tariff structure. Contemporary seaports are more dynamic, and operate as commercial entities while appreciating 'corporate governance' within the port and the port authority. Thus, to what extent seaport tariffs are used as a tool in the commercialisation of the port operation is a matter of concern. Third is the cost relatedness of the tariff structure. Formulating a pricing policy based on the cost structure combined with particular elements of these ports (such as port ownership, competition and sea port policy) is a vital task and the task is tedious in the absence of an emphatically tested, sound pricing model. The charges for the port infrastructure and services rendered by publicly managed channels, basins, terminals, quays, warehouses and berths of many ports are collected based on approved published tariffs. Analysis of the tariff structure indicates a multitude of charges for the various services rendered, and is apparently not a cost-based tariff.

Price competition is one way that port authorities can be exposed to seaport competition (Verhoeff 1981). If public authorities are in a position to subsidise port service operation, port services can be under-priced against competitors. Therefore a general proposition can be made that, as public authorities move away from port service provision, the significance of price competition diminishes. The charging structure of ship dues (dues on port infrastructure use) gives rise to two propositions. First, a port may adopt low prices for larger vessels and a relatively very high charge for smaller vessels calling at the port. The main objective of this policy may be to attract larger vessels and therefore more cargo (both container and general cargo). Despite the fact that port tariffs are not revised for considerable periods, ports aim for higher yields. The port pricing policy in use may contribute largely to this achievement. It is for this reason that investigating the determinants of port infrastructure tariffs is a timely exercise.

The pricing scenario for ports may give rise to a few key areas of investigation. First, has the worldwide port industry benefited from a different port pricing policy?. For example, charging larger vessels a low ship due and smaller vessels a higher ship due. Second, has the port authority considered the growth in the size of vessels[5], especially feeder vessels in designing the pricing policy? Third, the applicability and the appropriateness of the port's infrastructure pricing approaches needs to be researched in the light of the dynamic shipping industry which, according to UNCTAD (2014) exhibits increases in the size of vessels but a decline in the number of shipping companies and shipping calls.

The knowledge behind the tariff policy is the intent that lower tariffs (port dues) give incentives for more ships to call at the port and ultimately attract investments for industries. Therefore it appears that tariff policy is more likely to be oriented towards the goal behind economic development and the port is mainly concerned with its social function. The concept in the present context is considered to be traditional as the economic environment within which ports operate becomes more competitive and more ports behave in an oligopolistic manner. The concentration of market power by a port for cargo/transhipment cargo might influence the pricing decision. The market power of a market participant is not permanent and it depends on the ability of the

[5] According to Dynamar report (2007) the worldwide average size of a feeder ship run by common carriers is just 690 TEUs and the feeder container vessels are possibly 3000GT.

player to influence the price, quality of services produced and the nature of the product on offer. Seaports are dynamic service providers and tend to be proactive in addressing shipping market requirements due to changes in ship technology. Various marketing strategies are implemented in order to become a special point of contact for larger carriers with larger volumes of cargo and as result price wars or quantity setting competitions between seaports emerge as one of the dynamics of port operation and management.

2.3 THE NATURE OF PORT INFRASTRUCTURE CHARGES

Traditionally ports were considered as public assets. Therefore port pricing was based on the principle of *public good* pricing, with the objective being to maximise social welfare (Strandenes & Marlow 2000). As a result the pricing of port infrastructure in most ports around the world was under the purview of public statutory bodies, in most cases port authorities. However, this view has changed radically as a result of recent waves of port reforms and the greater active participation of the private sector and transnational port operators in the sector. Initial port reforms required that the cost-recovery approach to pricing be taken to lessen the financial burden on governments and ultimately on taxpayers. Subsequent port reforms allowed a more active role for the private sector in order to promote more competition in the sector and the use of external funding. These reforms have put pressure on ports to develop new pricing strategies that address their market position and enable them to achieve their corporate financial goals.

A port tariff structure consists of a collection of charges paid by port users, both cargo and vessel owners. Port tariffs are the main source of income for port authorities. The design of a suitable tariff structure is a necessary first step in port pricing. Tariff structures tend to differ substantially across countries and regions as a result of the variations in port governance models, national port policies, accounting and financing practices, and the objectives of port managements. Often, port infrastructure tariffs are identified depending on the type of infrastructure or service provided, e.g. channel dues, berth dues, pilotage, wharfage etc. Port tariffs also vary depending on the scale factor or charging unit that is used as the base on which the tariff is set. For example, some countries use Net Registered Tonnage (NRT)[6] as the

[6] Net Registered Tonnage is the Gross Registered Tonnage (GRT) minus the spaces of the ship which do not provide earnings.

scale factor for channel due and berth hire, while others follow the International Tonnage Certificate of Vessels established by the London Tonnage Convention in 1969 and use Gross Tonnage (GT). The use of the different scale factors is partly because NRT can be easily manipulated by a small change in the ship design, while GT or GRT more accurately represents the total volume of vessels. For many ports in the world which are operating in a competitive environment, determining the scale factor as a basis for port charges has been given a high priority. As a general examination of the use of different scale factors as the basis of various port charges, Heggie (1974) presented a comparison of the port charges for nine selected ports using different scale factors: NRT, GT, draft, Length Overall (LOA), the distance travelled (for pilotage), cargo tonnage and duration of service. For port dues, the most commonly used scale factor was either the NRT or GT of vessels. Nevertheless the sample size (nine) of the selected ports was too small to make any firm conclusions regarding the scale factor used for port dues and, as the study was conducted in 1974, the scale factor has presumably changed following port tariff reforms at each port studied.

As shown in Bennathan & Walters (1979), the common base for charging channel dues and berth hire in many developing countries is Net Registered Tonnage (NRT)[7]. Alternatively, Gross Registered Tonnage (GRT) is used as the scale factor for other ports such as Hong Kong and Port Kelang (Malaysia). The length of the ship (LOA) is also used as the scale factor for berth hire but is not employed by most ports in developing countries. Charging on the basis of the length of the ship is clearly related to the cost to the port to provide an adequate quay length or manoeuvring basin. Another efficient basis for port dues or berth hire is the draft of the ship though this factor involves measurement difficulties. The port of Rotterdam applied the draft as a charging basis for port dues. Zachcial et al.(2006) showed that the Port of Rotterdam charged harbour dues based on two user categories: seagoing vessels and inland vessels. Seagoing vessels were charged based on ship size (GT) and the amount of cargo loaded and discharged during a visit. Inland vessels were charged based on several factors: deadweight tonnage for cargo vessels, surface area for passenger vessels, and GT for sea going fishing vessels; all of which suggest that there was no

[7] Net Registered Tonnage is the Gross Registered Tonnage (GRT) minus the spaces of the ship which do not provide earnings.

common specific framework that formed the base for charging harbour dues for inland vessels.

Port infrastructure pricing practices have also led to several issues in port tariff design especially the basis on which port tariffs are fixed. For instance considering ship characteristics such as GRT, NRT, Dead Weight Tonnage (DWT), GT, Net Tonnage (NT) or draft of the ship as the basis for berth hire required formal justification[8]. ISL (2006) mention that GT has been used as the basis of port charges for almost 25 years across the European Union (EU), with the notable exception of French and Polish ports, which use a vessel's length, breadth and draft instead. The absence of a common basis may lead to another proposition that the port can fix different rents for different berths by taking in to account the rate of return of the investment made to provide the berth, which is easily calculated using the accounting cost. At the Port of Colombo (Sri Lanka) berth hire is charged as dockage per 100 GT. In addition a rental charge is levied for occupying a berth at a wharf, which starts one hour from the completion of discharging /unloading. Yokohama port (Japan) exempts a wharfage charge if dockage is charged, but charges rental for the use of land per square meter-month (ESCAP 2002). However the basis for the rental charges is not transparent. The evidence in the literature concerning the important scale factor and port tariff nomenclature used in other port regions is scarce.

When studying port pricing model determination the structure of port charges should also be considered, as well as the nomenclature of port charges and the important scale factor used to set port charges. An analysis of the port tariff structures of major ports in each region shows that the tariff structure is relatively varied but there are some commonalities. As shown later in this study, a comparative analysis of port/channel dues collected from 118 ports suggests that tariff nomenclature for port/channel dues tends to be significantly varied, although the purpose of the charge is necessarily the same. GT is used most widely as the scale factor for port charges. The nomenclature that the system of names used to refer port infrastructure charges and the scale factor of port dues on vessels used in selected world ports in major port regions is shown in Table 2.3.

[8] These measurements have evolved with International Maritime organisation (IMO) conventions i.e. a transition from the traditionally used terms gross register tons (grt) and net register tons (nrt) to gross tons (GT) and net tons (NT).

Table 2.3: Nomenclature and the scale factor of port infrastructure tariffs of selected world seaports.

Port Region	Port Name	Conservancy Charge		Berth Occupancy Charge	
		Name Used	Basis	Name Used	Basis
Western Europe	Antwerp	Tonnage Dues	GT	Berthing Dues	GT
Western Europe	Hamburg	Port fees	GT	Berth occupancy charge	GT
Western Europe	Rotterdam	Sea Harbor dues	GT	Quay Dues	LOA
Western Europe	Bremerhaven	Tonnage Charge	GT	Berth charge	GT
Western Europe	Felixstowe	Ship Dues	GT	Berth charge	LOA
Western Europe	Constanza	Port Access Tariff	GT	Quay Tariff	LOA/GT
Western Europe	Piraeus	Mooring charges	GT	Berthing Charge	LOA
Western Europe	Valencia	Navigational aids charge	GT	Vessel Charge	GT/hour
Western Europe	Barcelona	Navigational aids charge	GT	Port dues(berthing)	GT
South East Asia	Busan	Port Due	GRT	Berth Hire	GRT
South East Asia	Hong Kong	Port facilities and light dues	GT	Anchorage dues	GT
South East Asia	Kaohsiung	Buoyage	NT	Dockage	NT
South East Asia	Laem Chabang	Port dues	GT	Berth Hire	GT/hour
South East Asia	Penang	Port Dues	LOA	Berth Occupancy	LOA/Hour
South East Asia	Tanjung Priok	Navigation tariff	Fixed fee+ GT	Berth charge	GT
South East Asia	Tokyo	Port Dues	GT	Wharfage	Per hour
South East Asia	Ho Chi Minh	Tonnage	GT	Service charge	GT/hour
South East Asia	Manila	Port Dues	GRT	Dockage	GRT
South East Asia	Yokohama	Port Dues	GT	Wharfage	GT/hour
North American	Long Beach	-	-	Dockage	LOA
North American	Los Angeles	-	-	Dockage	LOA
North American	New York	-	-	Dockage	LOA
North American	Savannah	-	-	Dockage	LOA
North American	Vancouver	Harbor dues fee	GRT	Berthage Fees	LOA
North American	Oakland	-		Dockage	LOA
North American	Houston	Harbor fee	LOA	Dockage	LOA
North American	Virginia	-		Dockage	LOA
Africa	Mombasa	Port and harbor dues	GT	Dockage	LOA
Africa	Durban	Port Dues	GT	Berth Dues	GT
Australasia	Melbourne	Channel fees	GT	Berth Hire	Per hour
Australasia	Sydney	Navigation service charge	GT	Site occupation charge	Per hour
South West Asia	Dubai	Port Dues	GT/GRT	Berth charges	GT
South West Asia	JNU	Port Dues	GRT	Berth Hire	GRT per hour
South West Asia	Salalah	Port Dues	GRT	Berthing Charge	Per GT
South West Asia	Colombo	Entering Dues	GT	Dockage	GT
South West Asia	Jeddah	Port Dues	per call	Berth charge	GT
South West Asia	Sarjah	Port Dues	GRT	Berthing	GRT
South West Asia	Port Said	Port Dues	GRT	Berthing Dues	GRT
South West Asia	Bandar Abbas	Port entry dues	GT	Wharfage	per ton
South American	Santos	Port infra fee	GT	Berth fee	LOA

Source: Compiled by the author based on tariff published by 118 ports included in the appendix XIII (tariffs are published in official web sites of port authorities).

Table 2.4: Seaport infrastructure, services and tariff structure.

	PORT SERVICES	TARIFF AND THE TARIFF BASE
SERVICES TO THE SHIP FOR SAFE NAVIGATION		General tariff
	Aids to navigation	Conservancy, port dues: Charging unit - Vessel GT, GRT, NRT, LOA**, Length*Beam*Draft Differentiation - Type of vessel, GT**, GRT**, ship type**, traffic type**, LOA**
		Service tariff
	Pilotage	Pilotage: Charging unit - GRT/hour**, GT**, Vessel movement Differentiation – GRT**, GT**, LOA**, Ship type**
	Towage	Towage: Charging unit - Hours/Vessel movement Differentiation - Vessel GT*, GRT, NRT,Length*Beam*Draft
SERVICES TO SHIP AT BERTH		Service tariff
	Berthing/mooring	Berthing/Unberthing, Mooring Charging unit - Vessel movement Differentiation – Vessel GT*, GRT, NRT, Length*Beam*Draft
		Facilities tariff
	Berth Infrastructure	Berth Hire: Charging unit – GT**, GRT**, Meter-hour, Berth- hour, Berth-day Differentiation - Type of berth, GT**, GRT**, ship type**, traffic type**
		Services tariff
	Stevedoring	Stevedoring, Wharf-Handling, Receiving/Delivery: Charging unit - Freight ton, metric ton, cubic meter, TEU, box Differentiation - Form of cargo
		General tariff
	Wharf handling	Cargo Dues (Wharfage): Charging unit - Freight or metric ton, cubic meter, TEU Differentiation - Type of commodity
SERVICES TO THE CARGO		Facilities tariff
	Cargo Processing, Storage	Transit Storage (short term/long term): Charging Unit - hours/ Days Differentiation - Open or closed storage, days in storage
		Services tariff
	Equipment, short-term rental	Equipment Hire: Charging unit - Half-hour, hour, shift, half-day Differentiation - Type of equipment
	Processing to different form (Consolidation/deconsolidation)	Cargo Processing Charging unit - Freight ton, metric ton, cubic meter Differentiation - Type of storage (open, closed, frozen)
	Warehousing	Warehousing (long term) Charging unit - Week, month Differentiation - type of cargo

****** included by the authors based on the tariff review of 118 sea-ports

Source: Adapted from ESCAP (2002) and UNCTAD (1995).

The current study found 72% of the ports studied use GT/GRT as the scale factor when calculating port channel dues, with 53% adopting the same scale factor for berth occupancy charges. Only 21% of ports use vessel LOA as the scale factor when calculating the berth occupancy charge. UNCTAD (1995a) and ESCAP (2002) recommended that ports need to standardise their tariff structures in order to improve their business efficiency and transparency. The main objective of the standardisation is to produce a tariff structure that represents a general value-chain of a virtual seaport with specifically categorised tariffs for different port infrastructure, facilities and various services. Table 2.4 presents the nomenclature of port tariffs adopted from the tariff structures recommended by UNCTAD and ESCAP and the authors' review of 118 sea-ports.

In practice, given the multitude of port tariffs, the fundamental problem facing port pricing research in the present context is the practical implementation of pricing principles to pricing in the port sector. Button (1979) stated that 'it is unlikely that a port authority will ever be able to devise the ideal marginal social opportunity cost pricing policy-fluctuating demands, inadequate information, problems of administration are all likely to contribute to their problems of accurately pricing the port services'. Moreover Haralambides (2002) stated that, in the presence of better compiled, accurate and transparent port statistics on costs, formulating pricing policy for cost recovery should be possible. Further, based on a case study of European ports, Haralambides et al (2001) claimed that no best-practice port pricing formula exists, even in those ports where the pricing objective is to recover the full cost of the port services provided the pricing decisions are at the discretion of the management. Therefore the task of testing the practicability of pricing principles remains. However there is scope to clarify the principles of port pricing empirically and to screen the factors that drive seaports to adopt their own pricing strategies. However limited empirical research has been conducted on the pricing strategies used by ports. One such attempt is the ATENCO project (Haralambides et al. 2001), whose conclusions have been discussed above. In the European context, the study recognised a substantial difference in the port infrastructure financing and pricing practices across Europe. The difference was mainly due to the way the port management was organised, the degree of port autonomy and the composition of legal and traditional practices.

Differentiating charges for different types of port services has become one of the key strategies used by ports to secure their market position while competing in a market driven environment (Wilmsmeier 2007). As a result the structure of port infrastructure charges varies greatly, even though the basis of the charges is more or less the same. For example port charges in European ports exhibit a high level of differentiation (Strandenes 2004). In ports with high private sector participation the bundling of port charges has also been applied.

2.4 COST-BASED PRICING

The principle of cost-based pricing is that the revenue gained from port services needs to be sufficient to cover the cost of the port services, which can be classified into two categories: capital costs and operational costs (Heggie 1974). As Bennathan & Walters (1979) explained, there are two views on port infrastructure pricing, i.e. the European and Anglo-Saxon views. The European view is based on the macroeconomic objective of ensuring and facilitating economic growth in the port hinterland[9]. In contrast, the Anglo-Saxon view aims to ensure the financial sustainability of the port: port charges should allow the port to cover costs and where possible make some profit. As Bennathan & Walters (1979) pointed out, the efficient operation of ports requires ports to levy prices that are based on short-run marginal costs. This implies that, when demand for port services is sufficiently high to cause traffic congestion, the port can raise its tariffs by imposing a congestion charge. Alternatively when demand is low and the port has spare capacity available, it could use two-part tariffs to promote more traffic. Thus cost-based tariffs are only used by ports that aim to achieve financial sustainability and self-reliance.

According to the European Union's Green Paper (1997) port users should bear the real cost of providing port services. This would allow ports to cover new investments, operating costs, and the external cost of the production of port services. It is also expected that the cost imposed on port users (vessels and cargo owners) would be incorporated into the freight rate and would eventually be transferred to the price of cargo at destination. This ensures that new investments in the port sector are demand driven and will allow fair competition among ports.

2.4.1 MARGINAL COST PRICING

The marginal cost pricing strategy sets the price of port services (P) to equal marginal cost (MC): $P = MC$. Marginal cost is defined as the cost of producing an additional unit of output (Nichols 2000). In principle, companies apply marginal cost (MC) pricing where the market is competitive. MC pricing also aims at maximising social welfare i.e. social surplus, and allocates resources efficiently. For example, consider social welfare (SW) which is defined as:

[9] The hinterland is the word applied to the inland region lying behind a port, claimed by the state that owns the coast. The area from which products are delivered to a port for shipping elsewhere is that port's hinterland.

$$SW = TR + CS - TSC, \tag{1}$$

where: *TSC* is the total (social) costs

TR is the total revenue (Port Throughput, Q x Price, P)

CS is the consumer surplus

Maximize *SW* in equation (1):

$$\frac{\partial(TR+CS)}{\partial Q} = \frac{\partial(TSC)}{\partial Q}$$

Where: $\frac{\partial(\mathrm{TSC})}{\partial \mathrm{Q}}$ is the marginal cost. Since $(TR + CS)$ is the area under the demand curve, *D*= *P(Q)*, we can re-express it as:

$$(TR + CS) = \int_0^Q P(Q)\partial Q$$

Differentiation with respect to port throughput gives:

$$\frac{\partial(TR+CS)}{\partial Q} = \frac{\partial}{\partial Q}\int_0^Q P(Q)\partial Q = P(Q)$$

The MC pricing strategy is justified when the port is considered to be a public asset and therefore port users are required to pay for the marginal social cost which includes not only the financial marginal cost but also the marginal external cost i.e. port traffic congestion. Button (1979) assessed the viability of a more economic based pricing system and argued that the users of a port should be charged the full marginal social opportunity cost of the port resources consumed at a given time and, in order to ease the excess port traffic, incorporated a congestion charge for port users in the event of the port capacity being over-stretched.

Note that the MC pricing strategy can apply to different types of marginal cost, i.e. short-run marginal costs *(SRMC)*, long-run marginal costs *(LRMC)* or medium-run marginal costs. Button (1993) explained that the difference between *SRMC* and *LRMC* exists in the presence of returns to scale in the port industry. Further, *SRMC* equals *LRMC* if the industry experiences constant returns to scale and if it were less costly *SRMC* would be appropriate for the consideration of the tariff level.

Bennathan & Walters (1979) showed that, because of the economies of scale in the provision of port infrastructure and superstructure, the port operator will experience a financial deficit if the price is set equal to the marginal cost. Goss & Stevens (2001) confirmed the same view noting that it is only under some conditions that the SRMC pricing system maximises the social welfare. These conditions include a definition of marginal costs adapted to the accounting system where all costs including the full external costs must be taken in to account when prices are set, and the hypothesis is used that all prices in the economy must be set equal to the marginal cost of their production.

However, the MC pricing theory is invalidated in practice due to the presence of series of unquantifiable spill-over effects, the existence of imperfect competition and the presence of taxes (Button 1979). In the case unquantifiable spill over effect include the complexities arise due to MC pricing in the port as an business organisation and following managerial and financial issues. Further, in the debate over MC pricing, there exists a proposition that LRMC is preferred over SRMC. Haralambides (2002) argued that port pricing based on LRMC ensures the economic viability of the port. He explained that, in the presence of economies of scale, if the throughput level is less than the minimum efficient, setting the price equal to SRMC would result in a financial deficit and setting prices at LRMC would reduce the financial deficit. Accordingly if the objective of a port is to recover the cost of providing port infrastructure and services, LRMC pricing is the most appropriate. However, Bennathan & Walters (1979) stressed that setting SRMC pricing at less than LRMC encourages the use of port infrastructure. Haralambides (2002) also noted that, if the output is beyond the optimal scale, pricing at SRMC may result in port congestion which in the long term can be relieved by to the capacity expansion of competing ports that aim to capture some of the economic profit earned by the adjacent port. Thus the price again settles at the long term equilibrium (at the LRMC).

Based on the above conclusions and the directives of the European Commission's White Paper on fair payment for transport infrastructure which emphasised that the entire infrastructure complex of the EU as a whole may not exhibit economies of scale, Haralambides (2002) concluded that, at an aggregate level, it is possible to recover the total cost of port services by employing a MC pricing strategy. This is however notwithstanding the fact that the success of MC pricing is clearly based on theoretical justifications and certain assumptions related to competitive markets. Thus MC pricing has been subjected to criticism and has paved the way to alternative pricing principles.

Advantages of MC pricing

Marginal cost measures the additional resources utilised by supplying a unit of port services. Thus, in circumstances where port authorities have made inaccurate estimates in their development plans, MC pricing provides a basis for pricing port services. MC pricing enables the prices for different services of a port to be set so that the facilities are used efficiently and allows port authorities to testify that the variable cost of providing port facilities and services is covered.

The fact that port authorities are uncertain about the fixed cost and able to assess the variable cost of providing port services would bring about estimating marginal cost for port services. Thus the calculation of MC pricing requires less information than that for average cost pricing. In addition, the formulation of a MC pricing strategy based on the available information on variable cost is an approximation to the accurate marginal cost. Pricing just above the calculated marginal cost would recoup other unknown elements of the variable cost.

Disadvantages of MC pricing

As Vickrey (1955) pointed out, the producers of public services are hesitant to adopt marginal cost pricing to price their services because of its 'all ramifications as an absolute standard'. Efficient MC pricing only works in a perfectly competitive market. The main issue of MC pricing is the need for adequate revenues from operation as MC pricing will result in a financial deficit for decreasing cost industries. Thus, as seaports are a decreasing cost industry, the appropriateness of MC pricing is debatable unless the public port authority has the support of a perfectly costless source of revenues to finance the deficit. The straightforward consideration however is that the deficit is usually covered using tax income which follows the doctrine of subsidised ports, and is thus a burden on tax payers.

Another consideration with regards to MC pricing is competition. Unfair competition among ports in a particular port region may arise as MC pricing fixes prices below the actual costs, placing peripheral ports in a disadvantageous situation. Thus the case of adopting MC pricing in ports may be subject to competitive laws.

The lack of knowledge by port authorities of the costs of port operation is a constraint for pricing at marginal cost and makes the accurate compilation of port tariffs to account for infrastructure costs difficult. As a result making appropriate decisions on port investments to meet new or growing demands for port services is impossible and often misleading. Further, the success of MC pricing depends on the assumption that there is always spare capacity in all port activities. It also assumes that the port planning and adaptation to traffic flow are perfect. These are only theoretical concepts and are considered to be less relevant for planning port charging systems in practice.

Beyond the theoretical perspective, there are several practical implementation issues and barriers for the MC pricing strategy. The first such issue is the significant market power possessed by shipping lines (e.g. shipping consortia) and hub ports, these can create political barriers that impede the application of MC pricing.

Second, as most of a port's prices are determined and formulated subject to the relevant ministerial level of government concerning the management, finance and operation of seaports, the implementation of MC pricing is likely to be a sensitive political issue and to be hotly debated. Moreover, governments in developing countries may be required to pass new acts to restructure port pricing decision making mechanisms. For example the port tariff of the Sri Lankan port authority is subject to the 1979 Act No 51, clause 37 (1) which states that 'the charges that may be levied by the port authority for the services provided by the authority shall be fixed, and may be revised from time to time, by the authority with the approval of the minister who shall, before giving his approval, consult the minister in charge of the subject of finance' (UN 1989a). Similar situations are found in most of the Chinese, Korean and Australian ports. For example, the Port of Melbourne (Australia) is subject to the Port of Melbourne Authority Act (1958) and the Port of Melbourne regulations (1965) which both define the pricing power of the port authority. The Port of Melbourne is also subject to the Subordinate Legislation Act (1984) which defines pricing power and places constraints on raising rates and charges (UN 1989b). BTE (1989) stated that the market power of Australian port authorities and the demarcation of port authority policies including the pricing of port services, were determined by the legislative and executive powers of the state governments.

Third, the port authorities especially in developing countries have shown that there is a lack of available information and data pertaining to cost, making the assessment and formulation of new tariff regimes difficult. Information management is not sufficient to allow proper assessment of the factors pertaining to the new pricing design. For that reason, Haralambides (2002) claimed that a proper pricing policy required a better compilation of statistics, transparent port accounts and accurate accounting systems in every port.

2.4.2 AVERAGE COST PRICING

In adopting a suitable pricing principle, the central problem relates to a divergence between average and marginal costs (Coase 1946). This stems from two fundamental problems. First is the method by which costs that are common to consumers are allocated between consumers. Second is how the return of the fixed costs, which usually yield a rent, is determined given that the values of fixed costs are related to the factors of the production employed in the beginning of the production process.

Average cost (AC) pricing addresses many of the issues facing MC pricing and is applied when there is a need for full cost recovery; the price is set equal to the average cost of the production of port infrastructure and services i.e. P = AC. This leads to a break-even situation for the port operation which can operate further with normal profit generated by the pricing policy. Note that the early literature on public expenditure theories justified the provision of a particular public service at the cost of public capital and that the pricing of these services were exempt from the requirement of the full cost recovery from direct beneficiaries. The justification of this exemption was that the pricing promotes the use of the service which in turn produces multiple external benefits to the economy (Abouchar 1979).

With regard to seaports, tariffs imposed on vessels derived based on the average costs and the expected port traffic are advantageous as, provided the actual port traffic equals the expected port traffic, this strategy assures that the revenues collected offset the total costs. This approach is an appropriate pricing strategy to achieve budgetary objectives such as the aim to recover all the costs. Moreover the approach results in economies of scale if the port experiences an increasing throughput. Conversely this also implies that the outcome of AC pricing is inefficient in a situation where a port experiences less traffic. Thus there is a tendency to set prices higher when the demand for port services is less and lower when demand is strong. However, this approach discourages port callers with less ability to pay the price.

2.4.3 OPERATING COST PRICING

The operating cost pricing (OCP) principle is based on the unit variable cost of providing port services. Average variable cost pricing is a form of predatory pricing and it is a possible pricing strategy between competitive pricing and the pure predatory pricing (Rosenbaum 1987). In port sector, OCP is obtained by taking the total variable cost divided by the expected demand for the port services and facilities (ESCAP 2002). Since contemporary port handling is capital intensive in nature, variable cost tends to be less than fixed cost. However OCP is applicable to more labour intensive cargo handling operations i.e. break-bulk cargo handling operations. The pricing scheme is more rational in terms of covering the financial obligation involved in the provision of port services and ensures the maximum utilisation of port services provided at a given time.

2.4.4 CONGESTION PRICING[10]

Congestion pricing was first applied to road transport and in the form of a variable toll intended to reduce peak period traffic volumes to optimal levels (Litman 2011; Vickrey 1992). The congestion pricing method has been applied to ports where traffic exceeds the handling capacity of the port. Port congestion severely hinders the efficiency of a port and impacts on the selection of a port by port users (Tongzon 2009). Port congestion causes vessels to wait until a berth space is available and waiting is an additional cost for vessels. In most instances the waiting time of ships at ports is one of the major characteristics considered by shipping lines in port selection. To bring demand to a sustainable level the price of the commodity in demand (i.e. berth space) needs to be raised. In essence this suggests that ports may need to add a premium onto the existing port charges to reflect the cost of the externality generated by vessels to incoming vessels. In practice however port tariffs are not raised in the belief that rises in port tariffs would cause imported commodity prices to rise and exporting commodity prices to fall (Bennathan & Walters 1979). However the presence of port congestion even in the absence of congestion pricing in seaports affects domestic shippers and consumers as, in most cases, competitive tramp ship operators and liner shipping operators usually charge to cover the additional expenses

[10] This refers to pricing mechanisms designed to induce the economically-efficient use of congestible facilities. This method stems from welfare economics as a way of internalising the externality (the so-called Pigouvian Solution, A.C Pigou 1920)

due to ships waiting in the queues. In practice most ports do not openly engage in congestion pricing.

The rationale for establishing a port congestion charge, as described by Noritake (1985), is to decrease or eliminate such external negative effects caused by congestion. The literature on MC pricing suggests that pricing at marginal cost incorporated with a charge on congestion, results in a better pricing scheme which reflects the societal cost of the use of the scarce resources of the port. Nevertheless, in practice, the application of MC pricing including a premium for externalities (congestion, environment hazards, risk of accidents) is not found in the present port sector (Vincent 1989). Thus congestion pricing can be regarded as sub-set of social optimal pricing.

Advantages of Congestion Pricing

- In a congested port, application of a congestion surcharge brings the port infrastructure and superstructure to a socially optimal level of utilisation (Noritake 1985).
- Ports which are subjected to vicious shipping cycles are able to manage the port traffic and at the same time generate a flow of income which could be used to expand the existing port superstructures with more efficient technology, from which undesirable responses or effects from shipping lines can be mitigated.
- Levying a congestion charges instigates the use of existing port facilities at a more efficient level.

Disadvantages of Congestion Pricing

- A major obstacle to the implementation of port congestion pricing schemes is their administrative complexity and the unavailability of a mechanism by which the level of the levy can be determined based on the incoming port traffic.
- The attempt to internalise port congestion effects to port users will be substandard if port users pass the cost burden to shippers through increased freight charges (Strandenes & Marlow 2000)

2.4.5 MULTI PART TARIFF

The MC pricing discussed earlier tends to result in a financial deficit. The method also results in full utilisation of port capacity. Port operation is capital intensive and marginal cost, hence the prices set based on the MC principle tend to be low and result in overutilisation (Bennathan & Walters 1979). The MC pricing method is also difficult to apply in practice because MC can be defined differently depending on the variable input. To overcome these issues, Button (1979) suggested three alternative options to deviate from MC pricing i.e. subsidising port operation, imposing discriminatory pricing for users and applying a two-part tariff. The first part of the two-part tariff consisted of the marginal social cost, and the second part was a fixed charge for the right to use the facility, which enabled a port authority to still adhere implicitly to the MC pricing principle. This pricing method is based on the Ramsay pricing principle[11] which is designed in such a way that one party pays for the fixed asset cost recovery and the other party pays for variable cost recovery, or one party combines both cost components.

One approach to multipart tariffs is to give a regular port caller i.e. a liner service, a lower port charge compared to a casual port caller, i.e. a tramp service. This provides the justification for the discounted port charges currently applied by ports. This pricing system produces cost advantages to ship owners who call regularly into a port compared to casual callers, and also allows the port to plan a quay occupancy schedule in advance, to avoid underutilisation of capacity and time wastage. This also suggests that the multipart tariff can be used to solve berth allocation problems.

Types of multipart tariff systems

Bennathan & Walters (1979) identify four main parts of the tariff:

1. Lease a quay (LAQ)

   The port authority builds the facility and then rents this out to either a single user or to a shipping consortium on an annual or long term basis with tariff revisionary clauses. The rent is independent of the extent to which the facility is used. Other facilities required for the functioning of the quay will be charged by the port authority at the standard rate which is not stated in the lease agreement.

[11] Ramsey pricing is concerned with prices that maximise the sum of industry consumer surplus and profits. This version of *price discrimination* is sometimes called 'Second Best Pricing' since it deviates from 'First Best Pricing' where P = MC (*allocative efficient*). The basis is that those with a high willingness to pay (inelastic demand) have to pay higher prices than those less willing to pay (elastic demand), (Button 1993).

2. Annual fee to enter (AFTE)

   The introduction of an annual fee to enter the port allows ships to enjoy a lower entry fee per call and, in the event of a overcapacity situation at a port, the entry fee for the call can be virtually zero. The rationale behind the AFTE is to recover the dredging cost of the channel, and therefore the fee is related to the draft of the vessel. The AFTE is usually set to reduce as the number of visits by the ship to the port increases. Two decisions have to be made before designing the AFTE, these are:

   - Whether the charge should be levied only on the shipping firm or should it be paid by a wider group such as a consortium.
   - What selection methodology will be adopted to calculate the standing charge.

   The AFTE charge should reduce as the number of ship visits increases. This suggests that modified forms of the AFTE can be devised that provide a discount for ships according to the number of visits to the port. Alternatively a port authority, with the aid of a port marketing strategy could offer packages based on the number of visits during a year.

3. Container Charges

   Container charges result from the availability of an excess capacity of container terminals, the competition between ports for container traffic and the low and diminishing marginal cost of handling containers. Ports tend to charge a higher mark-up price over marginal cost to attract traffic and realise gains by providing faster ship turnaround times for container vessels (often owned by consortia). As the container traffic increases ports realise a fall in unit cost in container handling which, with investments in advanced container handling technology, allows them to keep charges low to realise economies of scale (Bennathan & Walters 1979). This way it is possible for a port authority to establish a charging system comprised of two prices: a low variable charge for handling and a fixed charge (rent) for the port facilities used by the liner shipping operators.

4. Shippers' License to use port (LUP)

   The LUP for shippers, similar to the AFTE, is another strategy that can be used to charge for the use of port facilities and services. A shipper, in this context is an agent who represents the vessel and pays on behalf of the services used by the vessel. The shipper can be charged a price equal to the marginal cost of the use of the facility and the other port services. The irregularity of the port use gives rise to a two part tariff, i.e. a regular charge and a special charge (which shippers use to base their decision on which port to choose). To attract shippers to the LUP system, the quantity discount method is used.

5. Port charges as a percentage levy

   This is applied in order to overcome some of the complications of multipart tariffs such as favouring shipping consortia, the difficulty in determining a fixed charge and the administrative complexity. In this case all port charges are converted into a percentage levy on the freight charge, i.e. port charges are recorded as a constant fraction of the freight charge.

However there is a difficulty in applying multipart tariffs to port services as the meaningful allocation of port costs between different types of port traffic is a very cumbersome exercise. In other words there is no single supplier of port services to a particular consumer or user in the port.

The advantages and disadvantages of multipart tariffs are listed below.

Advantages of Multipart tariffs

- The multipart tariff pricing strategy encourages the establishment of a regular port caller list, this makes planning berth/quay occupancy schedules easier, thus minimising time waste and waiting cost.
- The multipart tariff enables costs to be covered without restricting the use of the facility.
- In the case of LAQ, shipping consortia who lease the terminal tend to adjust their use of the facilities to minimise the cost and avoid underutilisation of the facility.
- The LAQ system encourages profit maximisation and increasing efficiency.
- LAQ provides an opportunity to combine public ownership with private efficiency.
- AFTE provides the basis for a charge to recover the dredging cost of a port.
- The AFTE system can be easily modified and port marketing strategies can be incorporated into the pricing policy.
- The LAQ system is particularly useful when there are commodity transits in mass quantities. Thus the leasing party would try to maximise the use of the facility.

- The opportunities for the LAQ system are boundless for terminals with larger containerised cargo and the method can be used as a bargaining tool for securing this traffic, while opportunities are limited for smaller containerised terminals and other unitised cargo markets.
- Container charges will encourage liner consortia to bid for additional traffic thereby making the port to realise constant gains from container handling.
- The container charging system is effective in extracting addition profit provided there is substantial competition among liner shipping for the container facilities and services provided by the port.

  The port charges as a percentage levy system could reduce the line shipping cost, thereby encouraging a lower freight rate.
- In the case of transhipment cargo, where the elasticity of demand for transhipment cargo is greater than for domestic cargo, the port charges as a percentage levy system would raise the revenue of a port. Thus a port could place its position as a potential hub.
- The port charges as a percentage levy system would encourage consortia vessels and other vessels to use the port more frequently with small loads of cargo.
- The port charges as a percentage levy system is, in an economic sense, a logical system of pricing as it automatically encompasses the variations in the general price level. This is because freight rates are reflected with the changing cost of shipping due to the increase and decrease in the prices of ship operating services such as bunkering, labour and ship prices.
- The port charges as a percentage levy system is the most simplistic charging method. It is not required to account for port costs in great detail.
- The port charges as a percentage levy system is more suitable for liner services as their services are concentrated in connecting major ports.

Disadvantages of Multipart tariffs

- The irregularity of ship calls makes the implementation of multipart tariffs difficult.
- Designing tariffs for regular port callers and casual port callers could be controversial.
- Lower tariffs for regular port callers places regular callers at an advantage over casual callers.

- There is currently limited application of the LAQ system to ports in the developing world.
- The LAQ system could lead to a creation of monopolised terminals owned by a shipping consortium.
- AFTE is applicable and implementable only when the facility is not subjected to congestion.
- The AFTE system confers greater advantages to a larger ship owner of liner ships or a consortium and is biased towards the large user.
- The AFTE system is therefore discriminates against non-consortium or single ship owners and would add further monopoly powers to shipping consortium.
- The AFTE system could hinder competition among non-consortium or single ship operators. The competition among non-conferencing ships provides the safeguard for trade in developing countries.
- The AFTE system is very complex to administer.
- The AFTE quantity discount system is effective when the port calls are dominated by few liner conferences.
- The LUP system incorporated with a quantity discount would be biased towards larger ships to allow them to be concentrated heavily in the port.
- The LUP system is difficult to administer particularly in the case of reselling it to other shippers.
- In practice however LUP could be confined to shipping agents rather than shippers.
- The proposition that port charges as a percentage levy would encourage consortia vessels and other vessels to use the port more frequently with small load of cargo is in practice unlikely to take place in the presence of liner shipping practices such as vessel pooling and vessel sharing.
- The revenue generated from the port charges as a percentage levy system would be vulnerable to the oscillations of the freight rate. This charging system is functionally related to shipping cycles.
- The port charges as a percentage levy system would be a move away from charging strategies that are based on cost. The port charges as a percentage levy system is no longer considering implicit costs such as the costs generated from the congestion of port facilities. Moreover the special charges such as storage charges, charges for extra labour use and quay use are not included in the levy.

- The port charges as a percentage levy system may be distorted in the hands of shippers and agents by quoting lower freight charges in order to claim benefits from paying less port charges. However this would not be possible in the case of liner shipping as freight charges are usually published.
- It is difficult to apply the port charge as a percentage levy system to tramp shipping on charter, where no specific freight rate is charged for cargo.

The multipart tariff strategy and its different forms demonstrate that there is no universal multipart tariff pricing strategy applicable to all port prices. Each system applied above would have its own advantages as well as inherent weaknesses. Multipart tariffs form the basis for strategic port pricing.

2.5 ALTERNATIVE PRICING STRATEGIES

Port planning and development, the port investment criteria and policies, and the port pricing policies and techniques are major aspects of port management. Port pricing policies and techniques based on the economic approach, as discussed under cost-based pricing, primarily opt for marginal cost pricing, taking into consideration the effects on all parties involved in the production of port services and the benefits derived by others. The financial approach, as an alternative to the economic approach, argues that the prices set are based on accounting costs, so that both the fixed cost and the variable cost are covered while realising an adequate return. Nevertheless both approaches feature inherited weaknesses and practical implementation issues which remain for further investigation and discussion. It is agreed however that the efficient use of port services requires each port service to be priced according to its respective cost of production. In a situation where the costs of port services which are usually paid by the shippers are high, a decision by port management to raise revenues to cover increased costs by lifting port charges on vessels will hinder the efficiency of pricing and distort the relation between port charges and the costs across all port operation, which are mainly in common. Thus, the pricing in this context needs to be an integral element in the strategic plan of a port.

While ports can set their tariffs using cost-based strategies, which are essentially based on the economic principle that takes into account production cost, there are other pricing methods that are not based on this economic principle. UNCTAD (1995a) following its first publication on port pricing in 1975, presented a report on 'strategic port pricing'. Research on port pricing undertaken since then has mainly focused on providing practical suggestions and recommendations for port pricing, and is far from producing a practical pricing solution that can untangle inextricably mixed port pricing practices.

2.5.1 STRATEGIC PORT PRICING

According to UNCTAD (1995a), the 'strategic port pricing' strategy takes into account not only the port's costs but also its performance and the value of its services. This approach is based on three elements: cost (C), performance (P) and value (V), the so called 'CPV approach'. It recognises the fact that improvements in both the financial and the operational performance of ports are necessary to deal with the emerging competitive environment within the maritime industry. Thus, strategic pricing is expected to help a port to achieve competitive advantages. The objective underlying the strategic pricing approach is threefold (UNCTAD 1995a, p.13):

- *'The cost-based tariffs are used to achieve the marketing objective of maximizing the use of port services and the financial objective of covering the variable costs of these services.*
- *Performance-based tariffs are used to achieve first, the operational objective of maximizing the throughput of port facilities while limiting the level of congestion experienced by users and secondly, the marketing objective of minimizing the loss of traffic owing to congestion.*
- *The value-based tariffs are used to meet the financial objective of generating sufficient revenues to cover the ports' costs and the marketing objective of limiting the loss of traffic as a result of generating these revenues'.*

The CPV approach is however based on the following assumptions: that the port charges being compared between ports are for the same port services; the ports being compared are competing for the same traffic; and the port costs alone should not determine the level of tariffs (which are seldom realistic). Given the increasing level of shipping market concentration, there is a need to expose shipping lines to more competition, and the strategic pricing of port services is needed (Bennathan & Walters 1979). It is customary that, by their practical operation, shipping consortia would not reduce freight rates when they can achieve cost savings through improving shipping operation or port services (brought about by forming strategic alliances and consortia), (Bennathan & Walters 1979). Despite this, recent developments in the liner shipping industry have diminished the ability of ports to apply strategic pricing. The formation of global strategic alliances among former liner shipping lines represents a new level of cooperation over major shipping route networks by optimising lines' assets through sharing vessels, ports, charters, terminals and joint scheduling of services (Slack, Comtois & Mccalla 2002).

Shipping consortia often practice price discrimination against shippers; by the origin, destination or value of the cargo. Strategic pricing by ports in this context can be applied directly as a counter discrimination method or indirectly as a method formulated to weaken the discriminatory price power of shipping consortia (Bennathan & Walters 1979). However this argument is invalidated in the presence of integrated global shipping alliances which can maintain stable freight rates over the same routes or in the same shipping regions. In addition the shipping alliances now have larger vessels and the sizes of vessels continue to grow. The survival of ports now depends on the ability of ports to satisfy the requirements of liner ships, such as deep channels and longer berth facilities, which can accommodate larger vessels with bigger drafts (Ryan 2002).

According to Bennathan & Walters (1979), one of the most visible areas of discriminatory pricing is ship due, as ports can impose charges based on the type of ship used by shipping line operators. Accordingly the monopoly power of liner consortia could be curbed by encouraging competition with a discriminatory pricing strategy favouring bulk carriers and tramp vessels, and charging relatively higher fees for liner consortia. This way the revenue loss from low port charges can be recovered while consortia are exposed to competition. Thus tramp shipping that enjoys lower port charges will be more competitive and in turn will be able to negotiate for lower freight rates than the conferences.

Despite the benefits that a port authority receives in terms of revenue, it is difficult for the port authorities to identify whether a vessel operates in a consortium or not. If this is the case, the ability of the port authority to impose counter discriminatory pricing strategies is weakened. Furthermore, the discrimination against liner consortia tends to exacerbate relationships between consortia and port authorities and sometimes even with governments. It is suggested that a port could realise a substantial position in a competitive shipping market rather than a monopoly market i.e. consortium. This however requires a long term strategy when a varying degree of competitive mix of shipping services is found in the port.

The only evidence for strategic pricing is found in privatised ports. Ashar (2001) presented a methodology for port pricing by analysing the strategic environment within which privatised ports have to operate and set charges in line with their organisational structure and strategic environment. His study supported strategic port pricing as a new method that differed from others discussed in the pre-privatisation era, i.e. MC pricing, full cost recovery pricing and multipart tariffs.

2.5.2 DISCRIMINATORY PRICING

Discriminatory pricing is based on the expression 'charging what the traffic can bear', which implies that the port charges are differentiated for a given service according to the individual customer's ability to pay. This is regarded as the best pricing policy from a social point of view when a public utility or infrastructure services are subject to budget constraints. Discriminatory pricing tends to be set based on cargo units.

There are some advantages involved in discriminatory pricing:

- Discriminatory pricing differentiates port charges for a given port service according to the individual benefits as revealed by the individual's ability to pay.
- Discriminatory pricing is the best pricing principle from the social point of view when a public port is operating under a budget constraint.
- Discriminatory pricing is meaningful as the capital cost of ports (which the port dues are meant to recover), could not be allocated between traffics. Thus discriminatory pricing promotes capacity utilisation which in turn keeps down the capital cost per ton of throughput.

A good example of discriminatory pricing is the Fully Distributed Cost Method (FDC). This method allocates common costs proportionally among the different services provided through a common infrastructure. As identified by Braeutigam (1980) for regulated industries in general, Bergantino (2002, p.361) re-stated the three general rules of the FDC method in the port context as;

- *'The distribution of shared costs on the basis of the relative quota of port output of the specific service with respect to total output (relative output criterion);*

- *The distribution of common costs on the basis of the share of costs directly imputable to each service;*
- *The distribution of common costs in relation to the gross revenues generated'.*

The discriminatory pricing strategy is implemented by using differential ship dues. The fees are levied according to the type of ship employed by liner operators, tramp service operators and bulk vessel owners. Ports can strategically set ship dues to control the monopoly power of liner consortia by encouraging competitors. Thus it is possible to discriminate in favour of bulk carriers or tramp services and charge higher fees for liner consortia. This way the port authorities may be able to recoup the losses from dues on under-priced tramp or bulk carriers. However this depends on the extent to which liner consortia react to the increased ship dues. It is important that liner ships do not pass the cost burden onto freight rates.

2.5.3 COMMERCIAL PRICING

The commercial pricing strategy is based on the notion that the price of a good or service should reflect its market value, e.g. its quality, durability and brand. By the same token, port services should be priced based on their quality. The quality of the port services is embedded in the generalised cost of using the port for users; of which time of stay in the port, low damage to cargo, high safety standards and ship turnaround time are critical for port selection. Strandenes & Marlow (2000) proposed such a pricing system with a view to maximise port competitiveness, however as in the other private sector market players, the objective of commercial pricing in ports is also to maximise profit. However there are exceptional situations in commercial pricing practices such that some categories of port tariffs are reduced below the general tariff level for specific vessel traffic categories with the objective of attracting more traffic. For instance, in the Flemish port of Ghent (Belgium), the removal of dock dues and lowering of mooring charges for container vessels operating short sea shipping is expected to bring about intermodal competition and more hinterland cargo to the port (Zachcial et al. 2006).

As noted by the Asian Development Bank, reforms in the port sector provide a strong justification for commercial pricing as they help to increase the operational efficiency, improve the chance of commercial success, promote timely port investments, reduce risk on return and provide access to capital (ADB 2000). In addition, the private terminal operators within public ports have also engaged in direct marketing strategies with shipping lines, commercial pricing and the differentiation in the quality of the cargo services provided. It is also recognised that, in the process of private sector participation in port terminal operation, the pricing structure of public sector port monopolies has been replaced with a commercial pricing strategy based on the value to the user, rather than on the average cost to the port (ADB 2000). In this context commercial pricing is a rather appropriate complement to port privatisation schemes.

2.6 PORT INFRASTRUCTURE PRICING: DIRECTION OF LITERATURE

This section aims to evaluate the existing literature on port pricing especially in terms of the trends in research on infrastructure pricing. Port pricing has been covered in many studies and various perspectives have been discussed (Pallis et al. 2011; Woo, Pettit, Beresford & Kwak 2012). Port infrastructure pricing has been the main area of concentration in studies by Dowd & Fleming (1994), Haralambides (2002) and Talley (1994). However, with only a few exceptions, most studies on this topic concentrate mainly on the theoretical and policy perspectives (Acciaro 2013). Several approaches to port infrastructure pricing from the theoretical perspective have been covered in the literature. One of the most popular pricing approaches is the cost-based approach as mentioned earlier. This includes marginal cost pricing by Abbes (2007a), Button (1979), Goss & Stevens (2001), Haralambides (2002a), Meersman, Monteiro, Pauwels, Voorde & Vanelslander (2007b) and Swahn (2002); average cost pricing by Gardner, Marlow & Pettit (2006); and cost-axiomatic pricing by Talley (1994). Other pricing approaches include strategic pricing by Ashar (2001), congestion pricing, priority pricing and port slot auctions by Strandenes (2004). Dowd and Fleming (1994, p.31) noted:

'Clearly there is no single pricing approach that is accepted and applied uniformly by all ports. Nor can it be said that there is a "best approach", given the diversity in port characteristics, types of ownership, philosophies of management, specific goals, etc. These differences are reflected in the pricing approach or combination of approaches that they [the port] use, and, of course, there are always cases of mismanagement and misguided policies!'

From the theoretical perspective, marginal cost pricing was favoured in the earlier research work of Button (1979) and Heggie (1974) as it helped to achieve a socially optimal outcome that made the most efficient use of resources. However, as discussed by Goss & Stevens (2001), Haralambides et al. (2001), Meersman, Monteiro, Pauwels, Voorde & Vanelslander (2007), and Meersman, Van De Voorde & Vanelslander (2002), while this method has many advantages, it is also subject to disadvantages, particularly the challenge of its application to port tariff design in practice. Together with the emphasis on achieving marginal cost pricing for port infrastructure, the relationship between the short-run and long-run marginal cost pricing has not been resolved adequately (Commission of the European Communities 1997).

Beyond the theoretical foundation and the practical implementation of marginal cost pricing for port infrastructure, a substantial number of extant literature focuses on the policy and practical aspects of port infrastructure pricing. These studies have attempted to unravel the issue of port pricing by approaching the subject from a multitude of perspectives. Overall, the methodologies and the research design of these studies do not provide sufficient scope for understanding the determinants of port infrastructure charges. The subject of these studies and their discussion has been centred only on the European port sector. This is mainly due to European transport policy prescriptions envisaging fair competition in the maritime sector, implying that port infrastructure pricing needs to be based on a commonly accepted pricing criterion. Accordingly studies commissioned by the EU attempted to explain how a fair port pricing policy could be achieved in the EU port context.

Concerning the policy perspective of port pricing, Gardner, Marlow & Pettit (2006) examined how the full cost recovery principle can be applied to EU ports. Their study focused mainly on the three ports of Felixstowe (UK), Dover (UK) and Dublin (the Republic of Ireland), and found evidence that the full cost recovery approach does not necessarily result in large increases in port charges. Their findings challenged the proposition made earlier by Baird (1999, p.1) that 'full cost recovery for private ports, privatised ports, as well as for public ports, remains an elusive ideal'. Perez-Labajos & Esteban Garcia (2000), Haralambides (2002) & Meersman, Van de Voorde & Vanelslander (2003) studied port tariff setting principles. Perez-Labajos & Esteban Garcia (2000) developed a methodology to evaluate efficient tariffs for commercial port services and proposed an objective function for all port services that could estimate the deviation of port tariffs from their optimal level. However, the methodological frameworks employed in these studies do not cover port infrastructure prices and costs.

From the perspective of port pricing practice, some studies address various issues in pricing practices. Dowd & Fleming (1994) provide a guide on port tariff design and identify the key factors influential to port tariffs. According to the authors, port tariffs can be designed in several stages. The first stage involves internal examination of historical costs, imputed costs and sensitivity analysis; the second stage is external examination; the third stage is to seek approval on the new tariffs; and the last stage is to decide the actual tariffs, which can be different from those approved by the authority.

The aforementioned review showed that there is difficulty in assessing port costs, particularly marginal costs, and in identifying the costs associated with specific port operations (Haralambides 2002). Existing studies on port pricing mainly focus on theoretical and policy perspectives and have limited empirical research (the former being largely on pricing principles and the latter on tariff structure and charging practices). Thomas (1978) provided a general description of port charging practices and analysed stevedoring charging practices in terms of their advantages and disadvantages. The study identified that the nature of demand for cargo handling services and the degree of inter-dependence between stevedoring companies are major determinants of a pricing policy, but have no relation to port infrastructure charges.

Following the same tradition of Thomas (1978), Dowd & Fleming (1994) conducted an empirical investigation of port pricing in general that encompassed the processes of port price determination. They proposed a guide to effective port pricing, based on the US and Canadian port system, and developed a procedure for port price determination. The port pricing procedure involved several stages: an internal examination in which port prices were calculated based on historical costs, imputed costs and a sensitivity analysis; an external examination; a determination of a tariff rate. The study is based solely on information gathered by the authors from North American ports and has no support from the port pricing literature. Therefore the output of the study can be considered as the generalisation of the pricing process in the US/Canadian context and a mere policy guideline for determining port charges. As a major weakness, the entire explanation is based on the explicit assumption of the availability of port cost data, which is rather unacceptable as this data is not transparent (Haralambides 2002; Psaraftis 2007), despite exceptional efforts from governments to make port costs and pricing structures transparent such as in the Flemish port sector (Zachcial et al. 2006).

Wilmsmeier (2007) advanced the literature on port tariff structure by analysing the tariff structure of European container ports in terms of the differentiation of charges from the port users' perspective. More importantly port infrastructure charge differentiation is viewed as a mean of securing a port's market position in a market driven environment characterised with increased competition and differentiation of port services. The research also highlighted the fact that seaports are required to be financially independent, following the Anglo-Saxon view. The findings of the study shed light on port infrastructure charges and its determinants. It has also been shown that the degree of port competition and the type of port governance model have direct implications on the port infrastructure charge differentiation. However the research does not consider the relationship between the degree of competition and the type of port governance model, with the port infrastructure charge differentiation.

Gardner, Marlow & Pettit (2006) have developed a questionnaire to survey port pricing practices and related issues. The survey covers general port information on throughput statistics, competitors, container traffic and hinterland modal share, and port pricing policy information. The pricing policy information largely requests financial data in terms of port costs and revenues. The accuracy of this data is not certain as Haralambides (2002) asserted that accurately measured port costs and relaible and comparable port statistics are not in existance, and importantly the port accouting sytems from which cost and revenue data are generated are not always transparent. The information gathered by Gardner, Marlow & Pettit (2006) on the views of port authorities on the pricing principles adopted has provided a general understanding of the pricing objectives of port authories and the motivation for port pricing. To furnish the gap of unavailability of a common tariff structure ESCAP (2002) produced a comparative analysis of port tariffs including port infrastructure, but the study was limited to the ESCAP region. In fact, the study only considered a comparison of the port tariff structures of ESCAP ports and did not consider factors influential to different tariff structures and levels in general.

2.7 CONCLUSION

As the port sector has evolved through different phrases of development, so have pricing practices. The review of the literature on seaport pricing principles has found that no single rule of thumb can be applied to all port charges and there is no common agreement on the way port pricing principles are categorised. However, the cost-based pricing approach that encompasses many pricing strategies provides a basic tool to determine port tariffs. The literature also indicates that port tariff formulation and practice can be complex and varies substantially worldwide.

Among the types of cost-based strategies, marginal cost (MC) pricing enables the maximisation of collective benefit and the most possible efficient use of resources, but does not cover the investment cost of the port. Essentially, this means that MC pricing is a price that maximises social welfare and in the current study the approach is referred as ‘social optimal pricing’. Alternatively, average cost pricing enables costs incurred by ports including capital investments to be recovered and consequently encourages investments and eases port congestion. It is understood that a significant constraint exists on average cost pricing, with the often opaque cost accounting systems seen in ports and the competitive pricing practices of ports acting as barriers. Multipart tariffs, often two parts pricing, enable ports to recover the cost of any investments and establishes a relationship with the marginal cost, whilst also allowing collective net benefits to be maximised. Ramsey prices have a specific nature that enable a minimisation of the 'loss of benefits' in relation to the marginal cost criterion or provide the basis for price discrimination. Compared to the other pricing practices the port charges as a percentage levy system is a straight forward pricing scheme.

The review of the literature has also identified different trends in the research into port pricing. The first is the debate concerning the principles of port infrastructure pricing from the theoretical and policy perspectives. This attempts to explain what an optimal port tariff should be, by drawing theoretical justifications and conducting empirical investigations, and also provides policy recommendations. The second is the port tariff structure and port tariff in practice, which is primarily concentrated on the analysis of port tariff structures, their determination and their application in the port sector. However empirical research on port infrastructure remains rather limited. Although typology of port pricing schemes are different and there are no accepted best practices in tariff designing, there is a need for a framework that could help to identify the determinants of port infrastructure charges and analyse their relationships. This is because, although the nomenclature and typology is different, the purpose of tariff design and the basis of charge are similar. It is also essential to gain insight into the practices and processes of port tariff formulation across ports worldwide despite differences in their governance models, competition and social and economic characteristics. Thus this study contributes to the literature on port pricing by way of identifying a set of distinctive factors that influence the levels of port infrastructure tariffs, infrastructure tariff design and infrastructure tariff practices.

CHAPTER 3 : AN EMPIRICAL INVESTIGATION ON PORT INFRASTRUCTURE TARIFFS[12]

[12] Based on this chapter, a paper entitled 'Determinants of Port Infrastructure Pricing' was presented in the second International workshop on Port Economics 2012 in Singapore and has been published in The Asian Journal of Shipping and Logistics, vol. 29, no. 2, pp.187-206.
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3.1 INTRODUCTION

External factors behind the changes in port operations and management have put pressures on ports so that competition has increased to levels never previously seen. These factors include the globalisation of production, changing maritime technology, the shifting of bargaining power to port users, particularly shipping lines and changing distribution patterns. Respectively, these factors have resulted in changes to port operations and management structures: ports have become value-adders; there is an increased need to improve port productivity; the bargaining power of a port has been influenced by the emergence of mega carriers and global port logistics service providers; and the arrival of hub ports has created more competition between ports (The World Bank 2007b). For ports to be efficient and competitive, port reforms have been undertaken worldwide with the private sector significantly involved in port operations, investments, development and management (e.g. ownership/partnership). Although most ports still have substantial market power, it is undeniable that ports are now under more pressure to become more competitive and responsive to changes in market conditions. Port competitiveness depends on a number factors, such as port and terminal charges, geographical location, water draft, feeder and multimodal connectivity, service reliability and stability, client relationship management and communication (Chang, Lee & Tongzon 2008a; Tongzon 2007). If a port wishes to stay competitive or improve its competitiveness strategies must be adopted that target these factors, such as: setting port tariff and terminal charges; improving operational efficiency; accommodating high shipping frequency; investing in infrastructure and cargo handling; and investing in information and communication technology.

This chapter presents an empirical investigation of seaport infrastructure tariffs with a primary focus on the determinants of seaport infrastructure tariffs as opposed to other non-infrastructure charges. The main difference is that infrastructure charges are often managed by the port authority, while non-infrastructure charges, e.g. cargo handling charges, are often managed by terminal operators. For most ports (landlord ports), infrastructure is owned by the state sector, and tends to be regarded as public goods and any charges therefore necessarily take into account the social welfare effect. Alternatively, if terminal operators are partially or fully owned by the private sector, then their charges would be subject to competition and be profit-oriented. While pricing strategies are often influenced by the cost of production, market structure, demand and institutional factors (Tyndall 1951), they are more complex for ports for various reasons. First, most modern ports operate as providers of multiple services, whose operations are interdependent. Therefore splitting the production cost for pricing purposes can be very difficult, if not infeasible. In addition, since infrastructure investments in ports are largely 'irreversible' and are therefore 'sunk' costs, operational costs play an important role especially in short-term pricing. Second, as ports are regarded as both public assets and businesses entities, their pricing strategies can vary substantially depending on various external and internal factors. Third, port pricing is often subject to strong regulations, and therefore changes to port tariffs and charges require careful planning and justification. Fourth, as ports are logistics nodes, pricing should take into account both competition between ports and competition within the supply chain, which implies that the equilibrium price can be even as in an extreme case outside the competitive-monopoly price range (Nguyen (2011). This is particularly the case where port users are highly dependent on the ports within the total supply chain (Robinson 2002).

There have been numerous studies of port pricing, however most of these studies focus mainly on theoretical or policy aspects. For example, European port reforms[13] have shown a new direction towards maritime pricing especially in port infrastructure with much focus on the full cost recovery approach (Gardner, Marlow & Pettit 2006), but little empirical research has been conducted to identify the influential factors of port infrastructure tariffs and their relationships. As highlighted in the literature review (Chapter 2), the difficulty in assessing port costs particularly marginal costs, and the identification of the costs associated with specific port operations are among the challenges in port pricing (Haralambides (2002); identifying and evaluating port infrastructure pricing with respect to its costs and possible determinants remains a major research gap. There is a lack of research to quantify the effect of various factors on port charges. Therefore this chapter and subsequent ones attempts to address this gap through an econometric analysis of the relationship between port charges and other factors.

This current study examines the infrastructure tariffs of 159 seaports worldwide and empirically examines the relationship between port charges and other factors using the

[13] EU policy on port infrastructure pricing is reflected on its two main policy directives: The Green Paper on Maritime and Port Infrastructure and the White paper on Fair Payment for Infrastructure Use.

simultaneous equation regression method. As many factors as possible are covered, depending on data availability, including those related to production, cost, market and institution. Because of the exploratory nature of the research the focus is on the main port infrastructure tariffs (i.e. marine charges) that are imposed on vessels, these are *port channel dues* (or *channel charge*) and the *berth occupancy charge*. Channel charge applies to the provision of navigation infrastructure including dredged channel and turning basins. For many ports this charge is also referred as *port due*. Berth occupancy charge is a charge for the use of a berth and is also referred to as *berth hire* in some countries. Data is publicly available data for both charges.

This chapter is organised as follows: section 3.2 presents the analysis framework using the simultaneous equation regression method. Section 3.3 presents the results of the analysis, which is followed by a discussion of results in Section 3.4. The conclusion is presented in Section 3.5.

3.2 PROPOSED ECONOMETRIC ANALYSIS FRAMEWORK OF PORT INFRASTRUCTURE TARIFFS

In this study, the simultaneous equation regression is applied to explore the relationship between port infrastructure tariffs as the dependent variables, and a number of factors as the independent variables (*Appendix IV and V*). Relevant diagnostic tests are also conducted to assist the data analysis. A test for simultaneity is conducted to determine whether the different types of infrastructure tariffs are subject to simultaneous relationships, and a test for normality is also conducted to confirm whether the conditions for *Ordinary Least Square* regression are met (*Appendix VI and VII*). The analysis covers the effect of not only of infrastructure-related costs but also other factors including port demand, administrative (legal) structures, governance models and geographical regions.

As explained in the previous chapter, port costs are among the most influential factor in port pricing. Therefore the econometric analysis will try to cover different cost related factors among other variables influential to port infrastructure pricing. Nevertheless, because of the unavailability of relevant data, mainly port costs and other factors like environmental costs, safety and security, port infrastructure specifications are used as proxies for port costs. Thus, the underlying assumption is that port infrastructure building and maintenance costs are strongly correlated with port physical specifications such as the depth, length and width of the access channel and berths (Kent & Ashar 2001). In this case the study also assumed that the channel is naturally deeper thus less maintenance is required (dredging) and shallow channels and berths with less depth alongside need higher maintenance costs. In addition, the analysis also covers the effect of other factors including port service demand, governance model, administrative structure and the port location. These variables are explained in more detail below.

a) Port infrastructure specifications

Due to the unavailability of data on port infrastructure costs, the regression analysis uses channel length, width and depth, and berth length and depth as proxies for port infrastructure maintenance costs. The justification for the use of these variables as port cost proxies is that the level of maintenance costs such as dredging costs is closely related to the existing length, width and the depth of approach channel; the longer and narrower the approach channels with less depth are expected to incur more costs for maintenance and vice versa. The use of berth specifications as proxies for the costs of maintaining berths can also be justified on the same basis; all else being the same, ports with longer berths and less depth at the berthing place are expected to incur more cost and vice versa.

b) Demand for port services

The level of demand for port services as represented by variable port throughput is included in the model based on the inverse relationship between price and the quantity demanded as explained by the theory of price. However demand for port services is derived from economic activities within a country and the volume of trade between the country under the study and its trading partners (Tongzon 1995). Thus the trade flow of each port country is included in the model to represent the level of economic activity that affects port demand. International trade flow determines the level of port activities and thus can be influential in determining the level of port tariffs. International trade can be dependent on many factors including macroeconomic factors such as exchange rate, interest rate, trade agreements and trade barriers. In addition, the cost of exporting and importing hence trade can be significantly affected by the infrastructure quality and standard, and transport costs including trade and port tariffs (De 2006).

c) Institutional factors

Institutional settings and the regulatory framework of seaports have a significant impact on port management and the decision making process. With this regard the port governance model within which a port operates can have influence over the port tariff determination. The level of public sector participation in various port production activities is determined by the port governance model adopted by the seaport. The analysis also takes into account the effect of various governance models, namely the *service port*, *tool port*, *landlord port* and *privatised port* models that are widely believed to govern the way ports are managed. This is partly because the governance model reflects the level of port reform, particularly the involvement of the private sector in port ownership and management. Ports operating under the service port model function as public entity, while port operating under the landlord model set tariffs and provide port infrastructure for private operators to run. On the other hand, privatise ports have the sole authority over entire port management and operation.

d) Port administrative model (legal structure).

In this study, the effect of the legal structures used by ports is also allowed for. The administrative structure of a port reflects its specific view on and preference for its corporate responsibility as a legal entity. According to Morris, Schindehutte & Allen (2005) an administrative model can be defined using either an economic, operational or strategic approach, with each approach having unique decision variables. Of the three approaches, the economic model is concerned with profit generation and thus the revenue sources, a pricing strategy, a cost structure, margins and the expected turnover are the main decision variables. Thus, administrative models of ports are included in the regression analysis with the objective of identifying their influence on port tariffs. Four legal structures adopted by seaports are covered in the analysis, including a public port authority, a port corporation, a limited company, and local government.

Given that different port governance models exist, the administrative model adopted by each port tends to vary with the port. The majority of ports are overseen by a public port authority and take the form of landlord ports. In the absence of a port regulatory mechanism, the sole authority over port investment, planning and financing, and formulation and regulation of the tariff regime is a public port authority (Trujillo & Nombela 1999). Yet, many landlord or service model ports have the administrative structure of a public port corporation or limited company. Thus, given the similarity existing in port governance, the level of corporatisation of port business can vary depending on the legal structure.

e) Geographical region of the port

The effect of the spatial distribution of seaport across world port regions is considered in the model to testify regional differences in port infrastructure tariffs. This is because ports located in the same region tend to have similar business practices, corporate cultures and levels of economic activities, which may affect their pricing regime. Regional-specific and country-specific factors may contribute to the determination of port tariffs. With this regard, the port regulatory mechanism of each port country and the port state control over pricing can significantly affect the level of port tariffs. For instance as shown by Dowd & Fleming (1994) if the tariffs of ports in a specific port region are set based on the public enterprise approach in which prices are set to promote local or regional economic activities and development, the level of tariffs in that region can be significantly lower compared to other port regions that follow different pricing approaches. To test this, the dummy variables for seven major port regions are included in the regression analysis as detailed below.

The estimated regression equation system based on log-transformed variables has the following specifications:

$$ln\,TRF_{ci} = \alpha_0 + \beta_2\, lnCHL_i + \beta_3\, lnCHW_i + \beta_1 lnCHD_i + \beta_4 lnPTP_i + \beta_5 lnTF_i$$
$$+\sum \beta_{6k}\, DPM_{ki} + \sum \beta_{7j}\, DPG_{ji} + \sum \beta_{8l}\, DPR_{li} + \beta_9 lnTRF_{bi} + \varepsilon_{ci} \qquad (1)$$

$$ln\,TRF_{bi} = \phi_0 + \theta_2\, lnBL_i + \theta_1\, lnBD_i + \theta_3\, lnPTP_i, \; + \theta_4 lnTF_i$$
$$+\sum \theta_{5k}\, DPM_{ki} + \sum \theta_{6j}\, DPG_{ji} + \sum \theta_{7l}\, DPR_{li} + \theta_8 lnTRF_{ci} + \varepsilon_{bi} \qquad (2)$$

Where:

- $i = 1,2,3 \ldots\ldots n$
- $lnTRF_{ci} = Channel\ due$
- $lnTRF_{bi} = Berth\ due$
- $lnCHL_i = Channel\ length$
- $lnCHW_i = Channel\ width$
- $lnCHD_i = Channel\ depth$
- $lnBL_i = Berth\ length$
- $lnBD_i = Depth\ alongside$
- $lnPTP_i = Port\ throughput$
- $lnTF_i = Country's\ trade\ value$

- DPMs are dummy variables indicating whether the port is a port authority ($DPM_1 \equiv DPMPA$), port corporation ($DPM_2 \equiv DPMPCR$), port public/limited company ($DPM_3 \equiv DPMLC$) or local government as the bench marking business model
- DPGs are dummy variables indicating the port is a landlord ($DPG_1 \equiv DPGLL$), service ($DPG_2 \equiv DPGS$), service-landlord ($DPG_3 \equiv DPGSL$) or private port as the bench marking governance model
- DPRs are dummy variables for geographical region, indicating whether the port is in the African ($DPR_1 \equiv DPRAF$), Australian ($DPR_2 \equiv DPRAU$), East Asian ($DPR_3 \equiv DPREA$), North American ($DPR_4 \equiv DPRNA$), North West European ($DPR_5 \equiv DPRNWE$), South Asian ($DPR_6 \equiv DPRSA$), West-Middle East region (DPR7=DFRWME) and the rest of the word as the bench mark

Cluster sampling was used in the data collection. In particular, ports were divided into eight (8) clusters on the basis of location: Africa, Australia, East Asia, South Asia, North America, North West Europe, West-Middle East, and the rest of the world. A total of 159 ports[14] were included covering all the ports whose data are available from Lloyd's Register-Fairplay's data base (Lloyd's Register-Fairplay Ltd 2011). The list of ports included in the sample is presented in Appendix XIII. Data required for the study included port infrastructure tariffs of world ports, port infrastructure specification data, port throughput and total trade of the respective port country. Port tariffs are quoted on the basis of US$(Purchasing Power Parity Index) per 100 GT/GRT. Port infrastructure specifications are in meters (m). Data were collected from several sources. Port infrastructure tariffs, channel/port dues and berth occupancy charges, and port throughput in metric tons were mainly obtained from the official port authority websites and, where no tariffs were published, tariffs were obtained by direct communication with port authorities. Port infrastructure data which includes port channel and berth specifications were obtained from the *Ports and Terminal Guide* published by Lloyd's Register-Fairplay Ltd (2011) and the official websites of respective seaports. Data on external trade as the sum of export and import values of each port country were obtained from the official website of the World Trade Organization (WTO). Since many ports quote their charges in their local currency, their tariffs were converted to a universally comparable common currency using the Purchasing Power Parity Index (PPPI) published by The World Bank. Data on the type of port management organisation (by searching for information how the port authority is incorporated), the port governance model (by searching for information on governance model) and the port region were also collected mainly from port's official

[14] Only seaports whose port infrastructure tariffs based on Dead Weight Tonnage (DWT), Gross Tonnage (GT), Gross Registered Tonnage (GRT), Net Tonnage (NT) were included in the analysis.

websites and the Port and Terminal Guide and analysed using dummy variables in the regression analysis.

Dummy variable for port governance were quantified using "1" and "0" for different governance models. For example the impact of landlord port on port charges was measured using "1" for landlord model ports and "0" for other governance models. The same was used interchangeably for other governance models. In the same manner the impact of port administrative model and the port location was also measured.

The regression model is estimated using the Ordinary Least Square (OLS), Two-Stage Least Square (2SLS), and Three-Stage Least Square (3SLS) estimation methods with different functional specifications. In addition to the OLS estimation, 2SLS and 3SLS are used to test for the simultaneity relationship between channel dues and berth occupancy charge. Further, several diagnostics tests were also conducted to test the statistical properties of the data and its functional validity. The normality of data for each dependant variable, channel/port dues and berth occupancy charges were tested using the Jarque-Bera (JB) normality test. For the selection of simultaneous equation modelling for the regression model, the Hausman test of simultaneity is also conducted.

3.3 ANALYSIS OF RESULTS: ECONOMETRIC MODEL

After removing the outliers from the sample the analysis includes 153 observations out of the original 159. Tables 3.1 and 3.2 present the descriptive statistics and a correlation matrix for the variables in natural log. As can be seen from Table 3.1, the standard deviations for all the variables are small relative to their means.

Table 3.1: Descriptive statistics of econometric variables.

VARIABLE	*N*	*MEAN*	*ST. DEV*	*VARIANCE*	*MINIMUM*	*MAXIMUM*
$lnTRFc$	153	2.3	1.3	1.9	-3.9	4.5
$lnTRFb$	153	1.9	1.4	2.1	-4.6	4.9
$lnBL$	153	8.3	0.9	0.8	6.1	10.4
$lnBD$	153	2.3	0.2	0.05	1.5	2.9
$lnCHL$	153	8.5	1.5	2.4	3.2	12.3
$lnCHW$	153	5.5	0.7	0.5	3.8	8.2
$lnCHD$	153	2.6	0.3	0.09	1.6	3.5
$lnPTP$	153	16.2	1.4	2.1	10.4	19.5
$lnTF$	153	26.1	1.7	3	16.5	28.5

Table 3.2: Correlation matrix of the study variables.

	$lnTRFc$	$lnTRFb$	$lnBL$	$lnBD$	$lnCHL$	$lnCHW$	$lnCHD$	$lnPTP$	$lnTF$
$lnTRFc$	1.00								
$lnTRFb$	0.39*	1.00							
$lnBL$	-0.14	-0.08	1.00						
$lnBD$	-0.08	-0.15	0.21*	1.00					
$lnCHL$	0.29*	0.02	0.19	0.10	1.00				
$lnCHW$	-0.08	0.02	0.14	0.23*	0.02	1.00			
$lnCHD$	-0.2 *	-0.09	-0.05	0.39*	-0.18	0.43*	1.00		
$lnPTP$	0.01	-0.11	0.55*	0.47*	0.36*	0.03	0.22*	1.00	
$lnTF$	-0.07	0.19	0.37*	0.19	0.19	0.10	-0.03	0.28*	1.00

Table 3.2 shows that the two types of port infrastructure tariffs (channel/port due ($lnTRFc$) and berth occupancy charge ($lnTRFb$)) are positively correlated (0.39). Two main reasons are postulated for this positive correlation. First, ports are consistent in their tariff setting: ports that set higher channel dues tend to set higher berth occupancy charges. Second, these two charges are affected by the same factors, e.g. geographical region, the governance model and administrative (legal) structure. The positive correlation (0.29) between the channel due ($lnTRFc$) and length ($lnCHL$) could be due to the fact that the maintenance cost of a channel depends on its length. The negative correlation (-0.20) between the channel due ($lnTRFc$) and depth ($lnCHD$) is probably because deeper channels require less maintenance. Port throughput ($lnPTP$) is positively correlated with berth length ($lnBL$), berth depth ($lnBD$) and channel depth ($lnCHD$) with the correlation coefficients of 0.55, 0.47 and 0.22, respectively. This implies that ports with deeper channels, and deeper and longer berths can accommodate larger ships and therefore have greater throughput.

Table 3.3 presents the results of the stepwise regression analysis using both the ordinary least square (*OLS*), two-stage least square (*2SLS*), and three-stage least square (*3SLS*) methods with different functional specifications. The number (in roman numerals) in the first column indicates the functional/model specification. The second column indicates the estimation method (*OLS*, *2SLS or 3SLS)*. For each model specification (from I to XI), there are two lines of regression results for equations (1) and (2) respectively. The third column shows the value of R-square.

The Hausman test for the simultaneity problem was conducted[15]. The Hausman test for the dependent variables suggests that $ln\,TRF_{bi}$ is determined simultaneously with $ln\,TRF_{ci}$ and they are endogenous. Thus a simultaneous equation system is appropriate. However, as shown below, the results obtained from all the *2SLS and 3SLS* methods are highly consistent with those provided by the OLS method. In support of the simultaneous equation analysis, the over identification restrictions of both regression equations was examined using the Hausman Specification test statistic.

The Hausman Specification test statistics for both simultaneous equations $ln\,TRF_{ci}(H = 11.29\ p = 0.0007)$ and $ln\,TRF_{bi}(H = 8.27\ p = 0.0040)$ are significant at the 1% significance level in which case the null hypothesis that some instruments used in both simultaneous equations (ln TRF_{ci} and ln TRF_{bi}) are not valid is rejected. Since the analysis used cross-sectional data, the heteroskedasticity corrected covariance matrix was used to address the heteroskedasticity problem.

As can be seen from Table 3.3 (p.69), the analysis identifies several factors that have a significant effect on port infrastructure charges. The following factors are highly significant: berth occupancy charge, channel length, channel depth and trade flow (of the country that the port is based in). Channel depth is however slightly significant in the model specifications except in *MODELs III* and *VII* with the coefficient of channel depth being -0.51 and -0.55 respectively, only significant at 10%. The berth length and depth variables, representing the cost of berth maintenance, are not significant.

The values of the coefficients of several dummy variables show the effects of different qualitative variables on port infrastructure tariffs. The coefficients for the port administrative model are significant but only for the channel due showing that the port authority and port corporation models do not have the same pricing system as the limited company and local government administrative models. The reason for this perhaps the berth occupancy charge is largely implemented along with the terminal handling charge. And since most ports are landlord ports, terminals are operated by private sector port operators and maintenance of terminals are also done by them. Thus

[15] The Hausman Specification procedure tests errors in variables and is useful to compare the differences in the estimates of OLS and IV estimation to detect the correlation between an independent variable with the estimated error term, which implies that there is simultaneity biasness in the dependent and independent variables.

berth occupancy charge of the landlord port has kept to a low level by the public port authority just to earn the long run economic rent of the infrastructure.

The regression results also indicate that the port governance model has significant impact on port pricing for some of the functional specifications under study. The results are however inconclusive. In addition, the port infrastructure pricing methods used in Australia and northwest European countries tend to be significantly different from each other, and from those used in the rest of the word.

As mentioned earlier, several diagnosis tests including the normality and simultaneity tests are included with the statistical analysis. The Jarque-Bera (JB) normality test statistic[16] was calculated to test the normality of the distribution of channel/port dues and berth occupancy charges (Table 3.4, p.70). The JB normality statistic calculated for channel/port dues was 6.9 indicating that the null hypothesis of normality of the distribution of channel/port due data cannot be rejected at 1%. The normality test conducted for berth occupancy charge also suggests a similar distribution.

16 The null hypothesis of normality is rejected if the calculated test statistic exceeds the critical value, in this case 5.99, from the Chi-Square, $\chi 2$, distribution with 2 degrees of freedom.

Table 3.3: Regression analysis results.

	MODEL (153 Observations)	R SQUARE	VARIABLES																				
			lnTRFc	lnTRFb	lnBL	lnBD	lnCHL	lnCHW	lnCHD	lnPTP	lnTF	DPMPA	DPMPCR	DPMLC	DPGLL	DPGS	DPGSL	DPRAF	DPRAU	DPREA	DPRNA	DPRNWE	DPRSA	DPRWME
I	OLS - lnTRFc	0.28		0.38***			0.26***	-0.07	-0.45	0.01	- 0.13**													
	OLS - lnTRFb	0.21	0.42***		-0.002	-0.6				-0.12	0.15**													
II	OLS - lnTRFc (DPM)	0.32		0.35***			0.27***	-0.14	-0.46	0.03	- 0.148***	- 1.06*	- 1.13*	-0.4										
	OLS - lnTRFb (DPM)	0.21	0.40***		0.009	-0.6				-0.12	0.15**	0.24	-0.06	0.5										
III	OLS - lnTRFc (DPG)	0.34		0.39***			0.28***	-0.07	- 0.51*	0.04	- 0.09*				- 1.06***	-0.33	-0.5							
	OLS - lnTRFb (DPG)	0.25	0.44***		-0.02	-0.7				- 0.15*	0.11				-0.05	- 0.83***	-0.3							
IV	OLS - lnTRFc (DPG,DPM)	0.38		0.37***			0.28***	-0.14	-0.46	0.05	- 0.11**	- 0.98*	-0.94	-0.4	-0.54	0.16	0.07							
	OLS - lnTRFb (DPG,DPM)	0.26	0.43***		-0.09	-0.6				- 0.16*	0.11	0.37	-0.04	0.5	-0.06	- 0.86**	-0.3							
V	OLS - lnTRFc (DPR)	0.36		0.36***			0.24***	-0.06	-0.49	0.03	- 0.11**							-0.3	0.82**	-0.33	-0.37	0.05	0.66**	0.4
	OLS - lnTRFb (DPR)	0.35	0.40***		-0.04	-0				-0.05	0.06							-0.2	-0.15	-0.39	0.04	0.94*	-0.02	- 0.87*
VI	OLS - lnTRFc (DPM,DPR)	0.39		0.35***			0.25***	-0.11	-0.5	0.04	- 0.12***	- 1.06**	- 1.14*	-0.6				-0.3	0.71*	-0.32	-0.28	-0.08	0.58*	0.41
	OLS - lnTRFb (DPM,DPR)	0.35	0.40***		-0.03	0.01				-0.07	0.06	0.37	0.53	0.4				-0.2	-0.19	-0.38	0.07	0.97*	0.01	- 0.87*
VII	OLS - lnTRFc (DPG,DPR)	0.40		0.37***			0.26***	-0.06	- 0.55*	0.06	- 0.09*				- 0.87***	-0.29	-0.4	-0.5	0.68*	-0.37	-0.31	-0.08	0.39	0.23
	OLS - lnTRFb (DPG,DPR)	0.37	0.41***		-0.06	-0.1				-0.06	0.04				0.13	-0.44	-0.1	-0.1	0.01	-0.32	0.03	0.97*	0.01	-0.68
VIII	OLS - lnTRFc (DPM,DPG,DPR)	0.42		0.37***			0.26***	-0.12	-0.49	0.07	- 0.10**	- 1.05**	- 1.06*	-0.6	-0.39	0.18	0.14	-0.4	0.57	-0.35	-0.19	-0.14	0.38	0.24
	OLS - lnTRFb (DPM,DPG,DPR)	0.37	0.41***		-0.05	-0.1				-0.08	0.04	0.43	0.45	0.4	0.01	-0.55	-0.2	-0.1	0.001	0.3	0.03	0.99*	0.02	-0.69
IX	2SLS-lnTRFc	0.27		0.44***			0.26***	-0.08	-0.43	0.02	- 0.13**													
	2SLS-lnTRFb	0.21	0.45***		0.004	-0.6				-0.12	0.15***													
X	2SLS-lnTRFc (DPM,DPG,DPR)	0.29		0.76			0.22**	-0.18	-0.27	0.09	-0.1	-1.06	-1.09	-0.6	-0.29	0.43	0.25	-0.3	0.46	-0.11	-0.14	-0.56	0.28	0.54
	2SLS-lnTRb(DPM,DPG,DPR)	0.36	0.35*		-0.06	-0.1				-0.07	0.04	0.38	0.4	0.4	0.004	-0.54	-0.2	-0.1	0.05	-0.33	0	0.99	0.05	-0.68
XI	3SLS-lnTRFc/lnTRFb(Sy R sq= 0.77)	0.11		0.97			0.19	-0.08	-0.37	0.12	-0.1	-1.08	-1.1	-0.8	-0.3	0.5	0.25	-0.2	0.38	-0.35	-0.17	-0.81	0.2	0.67
		0.36	0.33*		-0.05	-0.2				-0.06	0.04	0.36	0.38	0.4	-0.01	-0.55	-0.2	-0.1	0.07	-0.35	-0.01	0.98	0.07	-0.67

Significance levels: *10%, **5%, ***1%

Table 3.4: Jarque-Bera normality test results.

	JB STATISTIC	*P-VALUE*	α	*CRITICAL VALUES*
			0.01	*9.21*
lnTRFc	*6.9*	*0.03*	*0.05*	*5.99*
			0.1	*4.61*
			0.01	*9.21*
lnTRFb	*1*	*0.6*	*0.05*	*5.99*
			0.1	*4.61*

3.4 DISCUSSION OF RESULTS AND IMPLICATIONS

The result of the regression analysis presented in the previous section shows that seaport pricing is significantly affected by a number factors, namely channel length, channel depth, trade flow, various business structure and governance models, geographical region, as well as the relationship between the port charges themselves. This section discusses and interprets the results obtained from regression analysis presented in Section 3.3.

3.4.1 PORT INFRASTRUCTURE SPECIFICATIONS (PORT INFRASTRCTURE COSTS)

First, the analysis determined that there was a significant *two-way* relationship between the two main infrastructure charges (the channel/port due and the berth occupancy charge). The results indicate that the average value of the coefficient for berth occupancy charge (in natural log) is about 0.38, which is the cross elasticity of channel due with respect to berth occupancy charge[17]. This means that, if all else remains the same, a 1% increase in the berth occupancy charge is associated with a 0.38% increase in the channel due. On the other hand, the average value of the coefficient for the channel due variable (in natural log) of 0.40 indicates that, if all else remains the same, a 1% increase in the channel due is associated with a 0.4% increase in the berth due. The values of the coefficients for the other variables can be interpreted in a similar fashion. The significance of the channel length variable with the average value of its coefficient of 0.26 indicates that, if all else remains the same, a 1% increase in channel length of 1% would see a 0.26% increase in the channel/port due.

[17] This is calculated as the average value of the coefficients for the variable that are significant at 1%, 5% and 10%.

Berth infrastructure specifications, berth lengths and depths are found to have insignificant effects on berth occupancy charge. This may be due to the fact that there are other factors affecting the berth occupancy charge which may need a separate investigation. Moreover, in some ports, this charge tends to be incorporated into wharfage which is associated with the terminal cargo handling service[18].

The result does not indicate a significant relationship between channel width (*lnCHWi*) and channel due, while channel depth ($lnCHD_i$) is found to have a significant negative relationship with channel due. Although this variable is only significant in two regression models, its coefficient is consistent with the value of about -0.53, suggesting that a 1% increase in channel depth would decrease channel due by 0.53%. As explained earlier, the negative relationship between channel depth ($lnCHD_i$) and channel due ($lnTRF_c$) could be due to the fact that channels with sufficient natural depth require less maintenance and dredging costs. This interpretation is based on the assumption that the available data reflect the natural depth of the channel rather than the artificial depth achieved through dredging. The results provide evidence on the relevance of costs to port infrastructure charges. For example, longer and shallower channels require more maintenance costs, which in turn affect their respective charges. This also implies that deeper channels would require less dredging costs, which according to Ghosh, Prasad, Joshi & Kunte (2001) also depends on the geographic and hydrographic characteristics of the channel, and this data was not available for empirical study purposes.

The depth of port navigation channels is one of the major determinants of port competitiveness (Ha 2003; Tongzon & Heng 2005). For port approach channels with insufficient depths and widths the need for continuous dredging for easy navigation of vessels and the increase in vessel size, have led port authorities to undertake large scale investment in port infrastructure, superstructure and channel deepening (Woo, Pettit & Beresford 2011). Moreover port infrastructure standards and expansion efforts by port managing bodies have been featuring as elements in port competition (Ishi, Lee, Tezuka & Chang 2010). The provision of a dredge channel can be a source of economic rent for port authorities despite its social and economic development consideration as a public good (Baird 2004). The results of the regression analysis are also supported by the earlier findings of Wilmsmeier,

[18] As noted earlier, this variable could not be included in the current study due to the unavailability of its data for all ports included in the sample.

Hoffmann & Sanchez (2006), Wilmsmeier & Hoffmann (2008), and Oliveira (2010) that the improvements in the standard of port infrastructure such as berth length and maximum draft (deeper channels, turning basin and alongside depth) significantly reduce the impact of freight rate rise. This is primarily because, as explained earlier, ports with longer berths and deeper access channels charge shipping lines relatively lower berth and port access charges, and as a result the impact on voyage cost and therefore on the freight rate can be low.

With regards to port pricing issues in world ports across major port regions, such as the lack of cost-relatedness of port tariffs as highlighted by Haralambides (2002), the results provide clear directives to port policy on the pricing and financing of port infrastructure. The dilemma in the EU context of port pricing, and also in all modes of transport, is related to the establishment of fair price for transport infrastructure charges. With regard to port pricing, the commonly accepted norm is to undertake cost-based pricing of port infrastructure with the objective of establishing a level playing field for maritime transport and eradicating unfair competition and business practices. For other port regions where there is no official engagement of establishing a framework for port pricing, individual ports frame their own port pricing strategies which are mainly governed by the port policies of individual countries, the port's administrative and governance model, and port industry and shipping market dynamics. As a whole therefore the basic question, as EU port directives have proposed is, what is the appropriate basis for port infrastructure charges that all ports can have allegiance to, given the differences in economic and financial objectives, governance models, business models and port trade volume that exists among world ports?

Experiences in port pricing in the EU context suggests that major EU ports follow the cost-based pricing approach. Full cost recovery pricing is evident among EU ports, who has not significantly raised the port tariffs although they are cost related (Gardner, Marlow & Pettit 2006). This implies that seaports formulate port tariffs by considering the costs of providing port infrastructure services and the results presented in section 3.2 further confirm this specifically in terms of port infrastructure charges. The results provide port management organisations with clear evidence on the cost-relatedness of port infrastructure charges and directives for the formulation of charges. In order to remain economical and to provide efficient navigation services ports, especially self-financing ones with longer and shallower channels, are required to be cautious when setting channel dues, and to adjust their charges to take into account the level and cost of maintenance operations over time This is because longer and shallower channels require continuous maintenance, which over time results in a large capital outlay. Therefore the revision of channel dues against the periodic costs of maintenance is a pre-requisite for the efficient maintenance of port channels. The method of financing port infrastructure and its maintenance however can have impact on the level of the port infrastructure charge. Ports that operate with a regional and country economic development objective, which are mostly public ports operating under a port authority and which are often financed through public funding, set relatively lower port infrastructure charges compared to commercially operating ports with a corporate ownership.

Some countries have a common policy towards port infrastructure maintenance and port charges do not reflect cost-relatedness. For instance US public ports are not financially and operationally responsible for maintaining port channels. Instead a central government organisation, the US Corps of Engineers, is responsible for maintaining all the main US ports and their navigable waters (Fawcett 2007). Therefore, US public port authorities do not charge channel or port dues for vessels calling their ports. However, federal government financial constraints on the US Corp of Engineers have resulted in the restructuring of the role of the port authority in terms of port infrastructure provision and as a result, a port infrastructure maintenance charge (harbour maintenance tax on the volume of cargo passing through the port) has been introduced in some public ports to maintain port access infrastructure (Kumar 2002). Owing to the utilisation of US federal funds for maintaining channels, centrally introduced harbour maintenance imposed on shippers has been criticised on the basis that the user pay principle is not represented in the pricing policy (Ashar 2003). This scenario suggests that institutional set up of US public ports has given rise to some complexities in the US port infrastructure development, maintenance, finance and pricing endeavours.

The lack of the cost-relatedness of port tariffs has implications for port competition and efficiency. Inter-port competition promotes port efficiency. Barriers to inter-port competition constrain the enhancement of port efficiency. Port reform in the Spanish port system provides a good example of this. Although port reforms undertaken during the 1990's to enhance the autonomy of port authorities resulted in the growth of port traffic (Castillo-Manzano, López-Valpuesta & Pérez 2008), the overall efficiency of the port system including the efficiency of the port infrastructure has not significantly improved (González & Trujillo 2008). This is particularly due to the fact that inter-port competition was limited in the enacted laws of the port reforms, as port tariffs were uniformly set for all ports (Castillo-Manzano, López-Valpuesta & Pérez 2008). Further cost-based design of channel dues will result in reducing port development anomalies.

If channel dues are not cost-based, channel maintenance requires public funding support, which is mostly found in some EU ports and most US ports. EU initiatives on achieving cost-based pricing are mainly backed by the discrepancy in objectives and pricing practices adopted by subsidised ports and private ports. Subsidised ports are able to charge lower port dues than competing privatised ports whose objective is to recover investment costs (Ubbels 2005). These pricing practices affect the competition balance among ports as public funding for channel dredging in some ports places those ports which do not receive public funding in a less competitive position (Ircha 2001a). For the efficient operation of the port, it is critically important for the port managing body to have the full authority over the management of the port access channel. The disintegration of full authority or the separation of the port access channel management from the port managing body and its transfer to a separate management entity will hinder port efficiency as timely investment in channel deepening is not guaranteed. For instance, in the Australian port industry, the transfer of the Port of Melbourne access channel maintenance to the Victorian Channel Authority has impacted on the efficiency of the port (Everett & Robinson 2006). A similar situation can be found in the waterways between Brussels port and Antwerp port in Belgium where a high fee for the use of the channel has been the result of separate channel management bodies (Balen, Dooms & Haezendonck 2012). These examples suggest that cost-based pricing of port infrastructure maintenance results in a level playing field for ports and that channel management needs to be a sole responsibility of the port in order to have an efficiently functioning port operation. Thus, in order for ports to increase their competitive position and the efficiency of the port infrastructure, the autonomy of the port managing body to set and increase port tariffs is required. Once autonomous the port managing authority can set up cost-based port tariffs.

3.4.2 PORT DEMAND

The analysis results show that trade flow has a statistically significant, *negative* relationship on channel due, but no significant relationship with berth due. The negative relationship between trade flow and channel due could be because trade flow is strongly correlated with port output, which often exhibits economies of scale in port operation. This could also be because of the *demand effect*, whereby the lower the channel due, the higher the demand for port services. The value of the coefficient for the trade flow variable indicates that, if all else remains the same, an increase in total trade value of 1% is associated with a average decrease in channel due of 0.11%. The low value of the coefficient implies that demand for port services is inelastic. In addition, this could be due to the fact that port charges are a small fraction of total transportation costs and therefore port users base the port choice decision not on the port charge alone but on the total cost of transportation (OECD 2011).

3.4.3 PORT ADMINISTRATIVE MODEL

The legal and statutory framework of a port is an important enabler that balances the power between the port and the government, and addresses important questions regarding the commercial, managerial and financial autonomy of ports (Verhoeven 2010b). Thus, the effects of various administrative (legal) structures and governance models of ports can be evaluated through the coefficients of the dummy variables. The dummy variable for the *port authority* legal structure is significant (average value of the coefficient is -1.0375). This indicates that, if all else remains the same, channel dues charged by ports with the *port authority* legal structure are only 35% (=$e^{-1.0375}$ x100%) of those charged by ports with the *local government* legal structure[19]. Similarly, the value of the coefficient for the *port corporation* dummy (-1.11) indicates that the channel dues for ports operating under the *port corporation* business structure are only 33% (=$e^{-1.11}$ x100%) of those charged by ports operating under the *local government* legal structure. While the values of the coefficients appear to be large and therefore maybe questionable, the negative relationship

[19] This way of interpreting the numeral results follows the log linear form of the regression equation (1) used in the study.

indicates that ports operating under the *port corporation* legal structure charge less than those under the *local government* legal structure. This result may not necessarily reflect the true characteristics of the seaport population, the result might be due to the fact that the *local government* legal structure is typically preferred by small ports, such as found in New Zealand, that face demand constraints and diseconomies of scale and which therefore have to rely on higher tariffs to stay in business (Heaver 1995). Higher tariffs at some ports could be due to high local input costs, trade unions and labour/employment policies. Alternatively, lower channel dues are due to the *public good* nature of port infrastructure where tariffs are formulated to achieve optimal social welfare.

Market-driven business organisations possess the capability of effective pricing to overcome cost disadvantage (Vorhies, Harker & Rao 1999). Private port companies such as those in the New Zealand port industry, are given no financial support from central or local government, and operate as more market responsive corporatised business entities. This would suggest that their port pricing strategies are market-driven. Conversely, the tariffs of ports managed by a port authority administrative model might be formulated subject to the approval of the relevant ministries thus hindering the ability of the port authority to set tariff structures and restricting the level of corporatisation of tariff structures. The extent of this issue is reduced for commercialised ports operating under the port corporation business structure where the management is given more autonomy in financing and pricing. Thus the corporatisation of a port means an increase in financial autonomy and the ability to generate higher cash flows from port tariffs.

The dynamics of the port industry in Far Eastern countries such as Japan, South Korea, China and Singapore confirms the above disparity of port charges based on different port business structures. South Korean ports are operated under port authority business structures and charge relatively lower port charges compared to ports in other port regions. For instance the comparatively lower port charges of Pusan port (Korea) have attracted transhipment cargo originating from China and West Japan (Zan 1999), while in terms of the level of port charges, Osaka and Kobe ports (Japan) have relatively higher port charges (Ha 2003). This suggests that ports in Japan, largely managed by bureaus or local government port authorities (Morisugi 2000), and which operate under local government business structures charge relatively higher port charges. This also suggests that the pricing policies of South Korean ports are perhaps based on the public enterprise approach of pricing, while Japanese port pricing policy is cost-based. Port management bodies in Japan assess port dues and fees for the use of port facilities on a cost accounting basis with the objective of recouping the cost incurred for providing them (Ports and Harbour Bureau 2006). There is also a requirement, as stipulated in Article 6 of the Japanese *Local Public Finance Act*, for Japanese ports to be regulated to self-finance their operating costs (Terada 2002).

The business structure under which ports operate has direct implications on the way port charges are formulated which in turn affects the commercial business level of ports. Port management bodies are required to revisit their port pricing framework along with their business and market structure, and restructure their port business model to mitigate unforeseen adverse impacts on the port industry. The results also provide policy directives for regional port policy formulation in terms of inter-port competition. For example, a level playing field for port operation and competition for the Far Eastern region can be established provided that South Korean ports adopt cost-based pricing approaches for port tariff formulation. Unless this happens, the port industry in the adjoining countries in the region will shrink and these ports will only operate as gateways to and from hinterland markets.

3.4.4 PORT GOVERNANCE MODEL

The dummy variables for the governance model can also be interpreted in the same fashion as those for port business structures. The average value of the coefficient for the landlord model dummy variable (DPGLL) is -0.965 indicating that, if all else remains the same, the average channel due of landlord ports is only 38% (=$e^{-0.965}$ x100%) that of private ports. The average value of the coefficient for the service port model of -0.84 shows that, if all else remains the same, the average berth occupancy charge of service ports is only 43% (=$e^{-0.84}$ x100%) that of private ports, while the infrastructure charges of service-landlord (mixed model) ports are not significantly different from those of private ports. This finding is consistent with the idea that private ports are profit-driven rather than socially-welfare driven and tend to charge higher than landlord and service ports. The results also confirm the underlying pricing objective of ports, such that landlord ports are generally publicly owned and are not required to recover costs, while private ports are required to recover all costs including the investment costs in order to operate efficiently (Haralambides 2002). Privatised ports often restructure port tariffs to recover the cost of port infrastructure development and rehabilitation. For instance, in the port of Felixstowe (UK), the Harwich Haven Authority tariff has been raised with larger ships paying more in conservancy fees to cover the higher dredging costs as, including all other port services, the ultimate financial risk of port operation is borne by the private port (Baird 1999). As a result, owing to the fact that the payback period of port investment is longer and the nature of the investment is capital intensive (Baird 2000), private ports and ports with highly corporatised administrative models tend to levy relatively higher port infrastructure charges.

3.4.5 PORT REGION (LOCATION)

Differences in the level of port infrastructure charges can be related to the market structure, port pricing policies and the regulatory framework under which ports operate. Such differences could also due to the fact that the autonomy of port authorities in setting port charges differs with geographical region. For example port authorities in Anglo Saxon regions possess relatively higher autonomy over ports than those in the Continental port regions (Verhoeven 2011). Thus, port regions with ports operating under the continental model would not confer the total costs of port operation onto port users, any deficits are partially covered through the taxation of the wider group of beneficiaries of the port (Bergantino 2002). This suggests that different port regions follow different port polices on the distribution of port costs among participants in the industry. The results of the dummy variables in the regression analysis also confirm this proposition.

The significance of the dummy variables for the Australian ports (average value 0.73) means that, if all else remains the same, Australian channel dues tend to be about two times higher than those of ports in other regions. The average value of the coefficient for the northwest European region dummy variable (0.9675) indicates that, under the same conditions, berth occupancy charges of ports in this region are 2.63 times higher than those of the bench marking region (the rest of the world). This ratio is 1.59 for the channel dues of ports in South Asia and 0.41 for the berth occupancy charges of ports in the West-Middle East region.

There are two main reasons that Australian ports have relatively higher port charges. First, following the government's public enterprise policies, Australian ports are under pressure to be profitable or at least to ensure cost recovery (Everett 2009; Everett & Robinson 1998). Together with relatively high input costs, this tends to result in comparatively higher port infrastructure tariffs. Second, because of country-specific factors, most Australian ports have some market power and are allowed to price their services independently (Menezes, Pracz & Tyers 2007; Pettitt 2007). In order to achieve this, Australian ports adopt the *Fully Distributed Costs Method* which enables ports to have full coverage of total costs (Bergantino 2002). Australian ports possess some monopoly power and can price independently as the ports are the only gateways to the hinterland of each Australian state. Despite this most ports are overseen by an independent regulator. In the same region, the restructuring and corporatisation of New Zealand ports has seen these ports become more independent and operate as self-financing private port companies of which a substantial corporate share is owned by regional councils (Heaver 1995; Ircha 1999). Thus, port infrastructure tariffs in the Australian region ports are cost-based and profit-driven which results in comparatively higher port infrastructure tariffs[20].

3.5 CONCLUSION

This chapter examines port infrastructure charges using data from 159 seaports. The result of a simultaneous equation regression, with channel due and berth occupancy charge as the two dependent variables representing port infrastructure charges, indicates a two-way relationship between the channel due and the berth occupancy charge. Channel due is positively correlated to channel length, while channel depth appears to be negatively correlated. Trade flow appears to have a negative effect on channel due but no significant effect on berth occupancy charges. Overall, three propositions can be made with regard to the results on the cost-relatedness of port infrastructure tariffs using the simultaneous equation analysis.

a) The level of channel dues and berth occupancy charges are jointly or simultaneously determined and an increase in the level of one charge leads to an increase in the other.

[20] An in-depth evaluation of infrastructure pricing in Australian port sector was carried out and a paper titled 'Port Infrastructure Pricing Policy and Practice: A Case Study of Australia and New Zealand Seaports' was presented at the annual International Association of Maritime Economists Conference 2014 held in Norfolk, USA. (A revised version of the paper is under review in Australian Journal of Maritime and Ocean Affairs).

b) The positive coefficient of the channel length is significant and indicates that longer channels require more dredging, resulting in higher costs, which are reflected in the channel dues. This suggests that channel maintenance costs increase with the length of the channel.

c) The coefficient of the channel depth is significant. Its minus value implies that channel maintenance cost is lower for deeper channels. Thus port authorities can charge lower tariffs for port dues and channel dues with naturally higher depth.

d) The coefficients for berth length and depth are not significant, suggesting that berth length and depth and their maintenance costs are not reflected in berth hire charges. Some other exogenous factors appear to be responsible for the determination of the berth hire charge. Possibly many service ports can cover their berth facility charges using the cargo handling charges imposed on vessels. Nevertheless the coefficient is negative, which implies that as the berth length increases, the berth hire charge may reduce. Ports with many berths and longer berths can accommodate more ships and bigger ships, allowing the port to realise a higher output which in turn realises economies of scale. Thus, the costs of maintaining longer berths can be spread over many vessels calling into the port at a given time. In this sense, ports with many berths and longer berths charge lower berth charges than ports with fewer and shorter berths.

It is interesting to note that the channel dues charged by ports operating under the port authority and port corporation legal structures are lower than those operating under local government entity legal structures. Furthermore, landlord ports and service ports tend to charge less than private ports, implying that the former are supposed to play a dual role, while the latter are more profit driven. In addition, infrastructure charges of Australian and northwest European ports are significantly higher than the rest of the world.

The finding of the research has some implications for port policy, pricing committees, port authorities, operators and managers. Efficient pricing is a prerequisite to making efficient infrastructure investments (Winston 1991). While public ports should aim to maximise user welfare, given the growth in demand for port services, they may need to evaluate their pricing approach in order to reduce the financial burden and consider the competition by privately operated ports. Port managing bodies may be required to consider suitable mechanisms to establish cost-based infrastructure tariffs, especially those of self-financing port managing bodies. The result of the analysis strongly indicates that the cost-based approach plays a key role in port pricing, but that actual charges remain substantially different across port business structures, governance models and geographical regions in the word. In addition, very high charges by private ports may also mean their charges need to be monitored.

The study is subject to limitations that could be considered for future research. First, because of the unavailability of relevant data, port infrastructure dimensions were used as proxies for infrastructure costs. The inclusion of data on dredging cost if available in future research would help to reduce complexities related to the difference between the natural depth and the artificial depth of the channel. Second, due to its exploratory nature, the study only considered channel due and berth occupancy charges, other charges especially terminal charges were not considered. Thus, future research can extend the empirical framework proposed by current study and includes additional charges, especially terminal charges to cargo owners/shippers and charges for other services such as pilotage. In addition, future research can also incorporate the role of competition, vertical relationships along the supply chain and port-regional development.

CHAPTER 4 : RESEARCH DESIGN AND DATA ANALYSIS METHOD

4.1 INTRODUCTION

The research methodology is a vital and an essential component of the research process as the research outcome heavily depends upon the methodology adopted. For management studies, the research impact strongly depends on the appropriateness and the rigor of the research method used in the investigation (Scandura & Williams 2000). Thus the development and justification of the methodological framework are needed to achieve the research objectives. This and subsequent chapters aim to gain further insight into the port infrastructure tariff setting process and related issues. In particular a primary data collection instrument (a survey of international sea port managers) is conducted to assist in the analysis of the current knowledge and practice of pricing principles by seaport managers, the infrastructure tariff setting process, tariff setting and the factors that influence tariff setting. Thus the research conducted in this and subsequent chapters will complement the research presented in Chapter 3, which used secondary data to study the determinants of port infrastructure tariffs.

To achieve the research objective, a conceptual framework concerning port infrastructure tariffs in terms of port pricing theory, pricing objectives, factors affecting port infrastructure tariff design and current conditions and issues in port infrastructure tariffs in practice is presented. The research design including data collection, a questionnaire design and data analysis methods is also explained. In particular, the analysis will make use of primary data collected from a survey of international seaports. The questionnaire covers the current knowledge of port pricing held by seaport organisations, port pricing objectives, the factors influencing the design of port infrastructure tariffs and any existing port infrastructure pricing practices. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) will be applied to identify and analyse the underlying factors in the infrastructure tariff design and setting process.

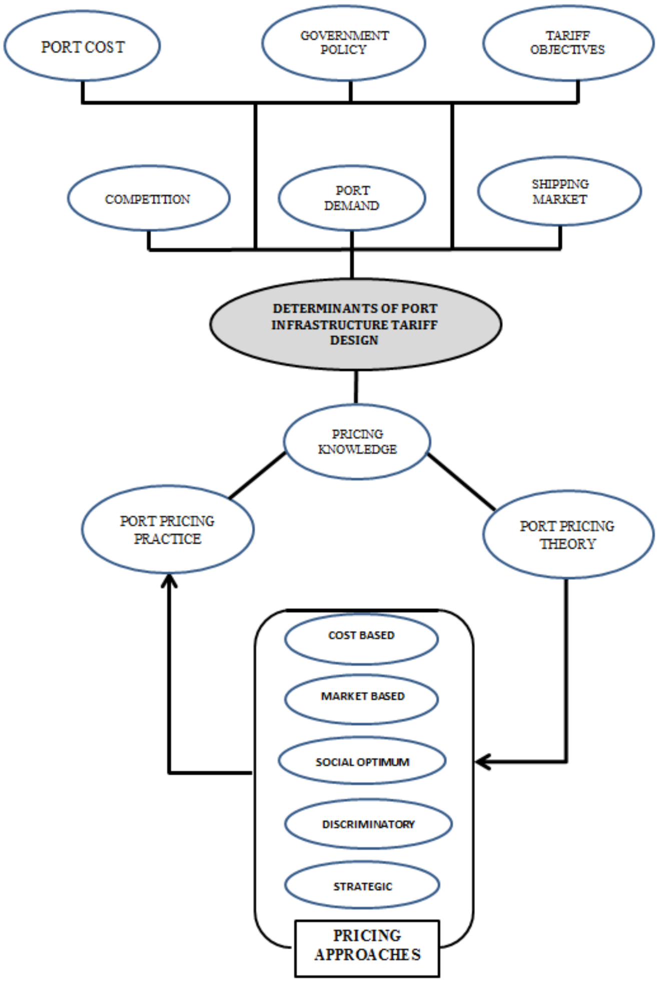
The current chapter is organised as follows: Section 4.2 provides explains the conceptual framework and the development of the survey questionnaire; section 4.3 presents the research design; section 4.4 explains the data analysis method; and section 4.5 provides a synopsis of the chapter and its conclusions.

4.2 CONCEPTUAL FRAMEWORK AND QUESTIONNAIRE DESIGN

4.2.1 CONCEPTUAL FRAMEWORK

As outlined in the previous section, the objectives of the primary data analysis are to test the level of knowledge held by port organisations about port pricing principles, their applicability and the various factors influential to port infrastructure tariff design and practices. The latter can be internal and external to the port organisations and are illustrated using the conceptual framework presented in Figure 4.1.

Figure 4.1: The conceptual framework for port infrastructure pricing.



The conceptual framework shown in Figure 4.1 identifies the theoretical and practical aspects of port pricing and recognises the following pricing approaches that have been explained in detail in Chapter 2 (the literature review) including:

- Cost-based pricing.
- Market based pricing.
- Socially optimal pricing.

- Discriminatory pricing.
- Strategic pricing.

Figure 4.1 also shows that port infrastructure pricing can be influenced by various factors such as:

- Port costs, especially infrastructure costs and maintenance costs.
- Policy and regulation, which in many cases dictates the method and process of port tariff setting.
- The tariff objectives set by the port authority.
- Competition, including the number of rival ports offering similar services.
- Demand, as governed by international trade and other relevant macroeconomic variables.
- The shipping market, especially the bargaining power that shipping lines have to negotiate port tariffs and charges with ports.

The conceptual framework above demonstrates how pricing knowledge, port pricing practice and port pricing theory are interrelated. The top section of the framework demonstrates that port infrastructure tariff design and practices are influenced by many factors including port policy, port competition, port ownership, port demand and port costs. Lower part of the framework demonstrates how port's knowledge on port pricing theory and ability to apply those theories affect the designing of port infrastructure tariffs.

4.2.2 QUESTIONNAIRE DESIGN

The study relies on a survey of international seaports as the key data collection instrument. The survey questionnaire was developed based on the literature reviewed in Chapter 2. The main part of the questionnaire includes questions concerning the existing knowledge that seaport managers have of port pricing principles and their application to the port infrastructure tariffs of their ports (Notteboom & Winkelmans 2001); the tariff objectives of the port (Meersman, Van De Voorde & Vanelslander 2003; Strandenes & Marlow 2000; Suykens & Van De Voorde 1998); the factors to consider when designing port infrastructure tariffs such as cost consideration, competition, stakeholder participation, and transparency; and the revision of port infrastructure tariffs (Haralambides et al. 2001; Meersman, Van De Voorde & Vanelslander 2003; Tongzon 2009). The following aspects influential to the port infrastructure tariff design are proposed for further investigation at the data analysis stage and are therefore included in the survey questionnaire:

a) Ownership.
b) Governance model.
c) Administrative structure.
d) Competition in the sector.
e) Knowledge of pricing principles and their applicability.
f) Objectives of tariff setting.
g) Costs, especially capital investment and maintenance.
h) Financial position.
i) The port users' perception of tariff levels.
j) Demand and the characteristics of the port user.
k) Government policies and regulation.

In addition, the following aspects of port infrastructure tariff practices are also proposed for further analysis:

l) Stakeholder participation in port infrastructure tariffs.
m) Transparency of port infrastructure tariffs.
n) The revision of port infrastructure tariffs.
o) Institutional arrangement for the design and revision of port infrastructure tariffs.

A copy of the survey questionnaire is provided in *Appendix I*. The survey questionnaire comprises of six (6) sections: A to F.

Section A: Seaport profile

This section seeks administrative information of the survey participants which includes the port's ownership and governance model, the port's administrative structure, the level of competition experienced by the port and its location. The main objective of this section is to identify and classify ports based on their location, ownership, governance and administrative structures, and level of competition.

Ownership structures tend to vary across ports (Commission of the European Communities 1997). Thus, this section aims to take into account the differences between the ownership structures of ports that may affect their infrastructure pricing policies. According to ILO (1996), government ownership of the navigational infrastructure is around 76% and berth related infrastructure around 63%. Given their stake in the port sector, governments can have significant control over the way infrastructure tariffs are set. Question A1 seeks information on the port ownership which includes the different types of ownership (such as central government, state-provincial government authority, municipal government, public private foreign partnership and private foreign/domestic companies).

Questions A2 and A3 seek information on the port governance and administrative structure of ports included in the sample from which the influence of different port governance and administrative structures on port infrastructure objectives and design can be drawn. Differences in the governance and administrative structure are also likely to impact on port tariff design. For example, according to Turnbull & Wass (1995), the landlord port model is the most successful port governance model to improve economic efficiency. Under this model, port authorities and government agencies play an important role in port governance in terms of the design of the concession agreement, its regulatory regime, the tariff regime and the mechanism by which the concessions are awarded (Notteboom 2007). However, the interference of the public sector in port tariff design has resulted in weaker financial performance and as a result new port governance models have been adopted. For example, Greek ports adopted a new port governance model by converting the traditionally state-controlled port organisations into publicly-owned corporations and, in order to make them financially viable, handing the administration of these ports over to commercially driven, autonomous port authorities (Pallis & Syriopoulos 2007). Furthermore the port governance model can also have direct implications on the tariff structure of ports. For example, as a result of Mexican port reforms, port tariffs charged by the port administration (*Administraciones Portuarias Integrales-APIs*) to ships for the use of common infrastructure are subject to price caps which are set at levels close to the long term marginal cost of each port (Estache, Gonzalez & Trujillo 2002).

Ports that are close to others, especially those that share overlapping hinterlands and/or forelands, tend to compete to attract cargo and vessels (Van Niekerk 2005; Veldman & Buckmann 2003; Yap & Lam 2006; Yap, Lam & Notteboom 2006). The level of inter-port competition can impact on port infrastructure tariffs. Competition strengthens given that ports with more traffic lower their port charges. Ports with high traffic levels can lower port charges mainly in the provision of berths, dredged channels and break waters (Tongzon 1995). Therefore port infrastructure tariffs can be used as a tool for inter-port competition. Questions A4 and A5 identify the location and the level of competition experienced by the survey port. Information collected from these questions will be used to analyse the impact of competition on the port tariff objective and port infrastructure tariff design.

Section B: Port infrastructure pricing knowledge

Port authorities tend to follow an existing tariff structure developed historically with subsequent periodic revisions. Port tariff structure and the related complexity of nomenclature in pricing terminology have led to the introduction of a model tariff structure (ESCAP 2002). As Abbes (2007) noted, port authorities need to have at least a minimal knowledge of the short term and long term costs of port infrastructure in order to make informed decisions on efficient port operation, to adopt the best financial and administrative strategies, and to make appropriate investment decisions. For example, when formulating port tariffs, accurate information on port costs and their accurate compilation are prerequisites for the implementation of marginal cost pricing (Haralambides 2002; Swahn 2002). In order for a port authority to compile cost statistics a theoretical and empirical knowledge of port costs is necessary. In this context, various pricing principles were suggested, namely: marginal cost pricing (Bennathan & Walters 1979; Goss & Stevens 2001 and Haralambides 2002); average cost pricing-full cost recovery (Hall & Hitch (1939); average variable cost pricing-operating cost recovery (Baumol 1996; Burns 1986); Ramsey pricing (Ramsey (1927) and two-part and multi-part tariffs and commercial pricing i.e. mark-up pricing (Strandenes & Marlow (2000). The White Paper of the European Commission (1998) recommends that all EU ports need to follow marginal cost pricing; there are many examples of the difficulty in evaluating the marginal costs of seaport operation and its application to the real world (Abbes 2007).

Nevertheless the application of the pricing principles in the seaport industry has not been fully examined, and the extent to which port authorities are aware of and understand these pricing principles is not clearly understood. As Goss (1990a, p.268) noted, 'most port authorities interviewed have been quite unable to justify their structure of port charges'. Section B of the questionnaire is designed to cover this issue of the level of knowledge that port authorities have on port pricing. Questions in section B1 concern the knowledge of port mangers of various pricing strategies such as cost based pricing, market based pricing, social optimal pricing, discriminatory pricing and strategic pricing.

Question B2 asks about the level of applicability of the pricing strategies. This question is intended to gain an understanding of port infrastructure tariffs in terms of their cost relatedness, their ability to promote efficiency, their simplicity and their discriminatory nature; 'A clearly articulated pricing strategy is a prerequisite to the success of a public port authority' (Dowd & Fleming 1994, p.30). Haralambides (2002, p.334) recommends that a marginal cost pricing strategy can 'rationalise demand and allocate scarce port capacity according to carriers' willingness to pay'. Alternatively, Bergantino (2002) asserts that, under natural monopoly conditions which experience economies of scale, marginal cost pricing does not allow for fixed cost recovery, and therefore only generates losses. Well-developed ports are yet to consider full cost recovery pricing. For instance, as estimated by Veldman & Buckmann (2003), container ports in the Antwerp-Hamburg port range needed to increase their port access charge (which covers dredging costs) in order to meet the targets of a policy of full port-cost recovery. Policy directives initiated by the EU have resulted in ports in the EU region having to at least revisit their pricing strategies.

Section C: Port infrastructure pricing objectives

The aim of Section C of the survey is to obtain information on the main objectives of the port infrastructure tariffs. As discussed by Haralambides (2002), the main consideration in the port sector is to establish an efficient port pricing system leading to a cost recovery taking into account a range of other objectives. These objectives can be varied based on the expected outcome. Ports might use port infrastructure tariffs as a tool for managing inter-port competition because, as Tongzon & Sawant (2007) noted, shipping lines consider port charges and connectivity to be the second most important factor when selecting a port. Some ports aim at competing for niche markets in the shipping industry and design their tariffs for this purpose. For example, vessels with higher transhipment cargo volumes calling at South Korean and Taiwanese ports have received substantial price discounts (Lirn, Thanopoulou, Beynon & Beresford 2004).

Alternatively, some ports design tariffs in order to promote regional development. Thus port infrastructure services are considered to be public goods (Baird 2004; Goss 1990a). For instance, most US ports are considered to be drivers of local economic development, local trade and job promotion, while achieving their internal commercial objective of maximising port throughput (Goss 1990c; Randall 1988). Although ports occupy a position partly as a public utility and partly as a private enterprise and offer port services, including port infrastructure, from a socio-economic approach (maximising social welfare); the capital intensive and technologically evolutionary nature of the shipping industry has forced the port industry to become highly capital intensive with higher level of investment in port infrastructure (Suykens & Van De Voorde 1998). To clarify the dual role of ports as public assets and businesses, Section C of the questionnaire focuses on the uncovering the objectives of port infrastructure tariff design.

Section D: Factors influencing port infrastructure tariff design

This section of the questionnaire is designed to obtain the perspective of port managers on the influence of some pre-determined factors on port infrastructure tariff design. These factors include: the port's capital and the operating costs of the port infrastructure; the financial position of the port; the service quality; total port costs to users; inflation rate and change in input costs; trade flow through the port; the number of ship calls; the vessel size variability; the tariffs of competitors ports; and government policies and regulation.

Port infrastructure and maintenance costs: The financial, economic and operational objectives of a port; the market share of the port; and the port traffic growth situation, need to be accounted for when formulating port tariffs (Frankel 1987). These factors can be highly influential on port infrastructure pricing in world ports as the governance and administrative structure, and the conditions under which ports operate and are managed, tend to differ significantly.

Port infrastructure costs (mainly capital costs in the provision of port channels, turning basins and berths) are significant components of port total finance. Thus port infrastructure construction projects are subject to rigorous economic evaluation in which the return on the investment and its sensitivity are assessed with respect to various plausible scenarios that involve financial risk. This is because possible cost escalations in the construction and maintenance of port infrastructure, the volatility in port demand measured in traffic flow, and the behaviour of competitors could result in stochastic financial returns on the investment in port infrastructure (Kakimoto & Seneviratne 2000). Thus, despite rather accurate port investment appraisals having been made, the financial outcome of port infrastructure has an element of risk. This leads to the conclusion that those decisions on port tariffs and their levels, especially those tariffs for infrastructure, are crucial in ensuring an adequate return on investment over the life of the port infrastructure. In turn the outcome of the financial risk assessment of port infrastructure construction and maintenance is highly influenced by port tariff levels.

In the context of a growing trend towards port privatisation, determining the individual cost share for port users of common port facilities in a port is vital to allow the fair and efficient allocation of common infrastructure costs (Bergantino & Coppejans 2000). This is particularly important where port infrastructure funding in developing countries is supported by international organisations such as the World Bank. In order to meet the conditions for borrowing, ports and their governing authorities are required to generate adequate incomes to maintain port facilities, replace port assets and finance a reasonable portion of total capital costs (Grosdidier De Matons 1986). Such circumstances have implications on the port infrastructure tariff design.

Inflation rate: Ports offer infrastructure and services in return for a cash flow that helps the port organisation provide sustained port infrastructure and other services. Port assets such as dredged channels and berth facilities incur depreciation and loss of value due to market distortions, Heggie (1974, p.19) states, 'avoiding these distortions such as overutilization of port infrastructure, a lack of finance for maintenance is to base the port dues on real costs and correcting dues for the changes in the time value of money'. The change in the value of money is reflected in the rate of inflation and the prices charged for particular uses of port services need to incorporate an inflation premium. Thus, accounting for the real value of providing port infrastructure guarantees the rate of return on the capital spent on providing that port infrastructure.

Financial position of the port: A clear and transparent link between port costs and pricing is viewed as an important and necessary requirement for ports, as ports should set their tariffs so as to generate sufficient revenue to cover their costs and to meet their financial objectives (ESCAP 2002). However, ports in a strong financial position can use their pricing policy to foster their competitive advantage; those ports which are financially strong are able to offer lower port charges, and so stay competitive in the market. US port authorities are the best example: the ability of US ports to issue long term bonds that yield tax free interest has attracted larger investments into these ports and raised their capital position. In effect, public port authorities have been able to offer lower port charges (Goss 1990b).

The differences in port infrastructure financing can also influence the port infrastructure tariff design. This section of the questionnaire is designed to obtain information on the impact of different port infrastructure financing practices and private sector participation on the pricing practices. The question of the economic and financial viability of port infrastructure development raised by the European Commission (1997) needs to be justified in a broader context by examining whether private sector participation in the port sector leads to a more commercial attitude towards pricing and infrastructure funding. Further, the information gathered from this section provides the opportunity to understand the extent to which public sector ports and other undertakings deal with each other concerning port infrastructure financing, pricing and the level of involvement in port infrastructure investment in the world context.

Port user costs: Port users makes their decisions based on their perception of the service quality and port charges. Some port users establish relationships with port authorities and arrive at longer-term agreements for the use of port infrastructure facilities (Heaver, Meersman & Van De Voorde 2001). Where there is inter-port competition and port users can negotiate with ports about the level of port charges, port charges tend to be more competitive (BTE 1989). On the supply side, in a competitive environment port authorities need to negotiate with the users and use different strategies (e.g. long-term agreements) to maintain their customer loyalty (Heaver, Meersman & Van De Voorde 2001). However, such long term agreements tend to remove the flexibility and ability of users to negotiate tariffs and change port (Pallis & De Langen 2010). Alternatively, ports may rely on other means to deal with users in a competitive environment such as tariff negotiations, rebates and volume discounts. Some ports offer discounts on port tariffs depending on the volume of business negotiated with port users; for example Ningbo (China) provides a 10 to 30% discount depending on the volume of business negotiated (Cullinane, Teng & Wang 2005).

Port demand and service quality: Ports under one authority can levy uniform charges. For instance, port authorities in Israel, Papua New Guinea, Canada (under the former National Harbour Board) and some port authorities in Australia (under the former Maritime Board in New South Wales) apply uniform port charges to all ports regardless of port cost levels or port demand conditions (Goss 1990a; Goss 1990b). However port reforms and the need for a cost recovery pricing approach have led to more rational port tariff structures. Port terminal charges are influenced by trade volume and service quality (Tang et al. 2011), factors which are covered by question D7.

The tariff level of competing ports: The environment of competition within which a port operates influences the way the port sets its tariffs. High volumes of domestic traffic, good hinterland connections, adequate feeder networks, good infrastructure and more importantly competitive port pricing are among the most important factors in the formation of a hub port (Aversa, Botter, Haralambides & Yoshizaki 2005). Competitive pricing tends to make total port tariffs competitive and lead to a regional tariff structure (Frankel 1987). For instance, financing or port charging practices in the European port sector may not only be affected by the ownership and/or the operation of a port, but also by the competitive position of the port (European Commission 2001). For example, the intra-port monopolists in highly competitive port ranges such as Le Havre-Hamburg are forced to set port charges competitively (Notteboom 2002). Furthermore, the degree of inter-port competition places a ceiling on individual port charges which in turn restrains port organisations from setting port charges to generate full cost recovery (Gardner, Marlow & Pettit 2006). The argument being that, if a port does set its charges to generate full cost recovery it will lose its customers to its competitors. However some ports (for example some EU ports) have state funded port infrastructure, and their tariffs can be priced at lower levels relative to self-funded ports. This has resulted in unfair competition among ports as port users are more attracted towards the ports with lower prices. In addition, increased inter-port competition has resulted in the substitution of cost based prices for those prices based on monopolistic port behaviour featuring discriminatory pricing practices (Goss & Stevens 2001). Thus, the only solution to circumvent different port pricing practices and the resulting unfair competition is to introduce market based pricing principles for port infrastructure (Commission of the European Communities 1997). This discussion suggests that ports should consider their competitive environment when setting port tariffs.

Government policy – government policy on port financing and regulation: The strategic role of transport infrastructure is considered to be a critical success factor for a competitive advantage and the internationalisation of supply within the context of ever increasing demand for the mobility of goods and people (Nijkamp & Rienstra 1995). Thus, most governments place a high priority on transport infrastructure in their investment policies. Owing to government budget-tightening and an ideological dislike of the public financing of transport infrastructure most countries in the world look closely at options for Private Public Partnerships (PPP) (Kurek 2010). A wide variety of port financing approaches has ensued as a result of the differences in port governance models (European Commision 2007). Among these private sector funding has increased due to increasing demand for port capacity following burgeoning world trade, containerisation and container traffic, and the extension of ship capacity (Boeuf 2003). These private investments are mainly concentrated on superstructure while the public sector mainly contributes to port infrastructure investments (Debrie 2010). Nevertheless many European countries plan to replace such tax-based public financing of infrastructure with a system based on user charges (Knockaert, Evangelinos, Rietveld & Wieland 2009).

The questions in Section D concern related factors that influence the design of port infrastructure tariffs. This section covers the effect of the key factors such as capital cost and operating costs, a port's financial position, shipping market dynamics, port competition and government policy and regulation towards ports which are captured in the questionnaire survey of port managers.

Section E: Port infrastructure pricing practice (people involved, the level of transparency and tariff revision)

This section of the questionnaire looks at the infrastructure pricing framework of a port in terms of port infrastructure pricing practices such as tariff negotiations, the tariff setting and revision approval process, the parties involved, the level of transparency and the reasons for tariff revision. The survey seeks to capture the port infrastructure tariff in practice with the intent to develop a framework that identifies the factors contributing to various tariff designs.

Stakeholders' involvement in tariff design

Dowd and Fleming (1994) state that the external examination of port tariffs with the participation of port users allows ports to negotiate port tariffs and establish a negotiated price for every port service. These port users basically comprises with shipping lines and cargo owners. Obtaining their feedback on designed tariffs is beneficial in terms of establishing port customer relationships and a port price that can be imposed for a certain period of time for the use of the port. Nevertheless, there can be consequences for the financial position of the port as the negotiated price may be substantially lower than the internally determined port price. In addition, a government's involvement in the port tariff decision making process will further impede the ability of the port organisation to be financially viable, to establish and to exercise cost based port tariffs. In most instances the freedom of seaport authorities to charge for port services on a cost basis is curtailed by the decisions of governments concerning the design and the level of port charges (Juhel 2001).

Transparency: policy directions for designing tariffs, public tariffs, negotiated port charges, lump sum port fees, and the regulation of port infrastructure pricing

The European Commission's ((1997) study is mainly concerned with the issues and suggestions for pricing principles such as user pay and transparency in port pricing. The questions in Section E2 mainly examine the level of transparency in port infrastructure tariffs. They include policy directives for port pricing practices such as the legal and policy framework, the nature of the tariff design process, new tariff imposition, tariff regulation and negotiation.

(a) Policy direction for tariffs: Policy direction and the process for port tariff setting are important elements to understand as the practice of port infrastructure pricing is primarily influenced by the institutional set up under which the directives for port operation originate. Government policy directives on the pricing of port infrastructure have influenced the tariff design and setting process, and as a result, various tariff structures have been established. Examples include the member states' support for infrastructure charging in the EU (Commission of the European Communities 1997) and the Greek government's involvement in financing and tariff setting for infrastructure (Zachcial et al. 2006). Some public port authorities (for example those in Bulgaria, South Korea, Taiwan, Italy and Argentina) structure port infrastructure charges in such a way that they can be applied uniformly to all ports in the country. This makes the imposition and the collection of port charges simple and convenient.

(b) Public tariffs: It is generally accepted that a port that is a common user facility and a provider of public port infrastructure to any ship requires a transparent pricing structure (Eriksson, Gullne, Lindvall, Karvonen, Saurama, Göthe-Lundgren, Mellin & Lindberg 2009). Thus most port tariffs are made publicly available by port authorities and the decision to publish may possibly depend on the organisational set up of the port. In some ports publishing port charges is a legal responsibility of the port authority. For example, in Japanese ports, the design and publication of up to date port tariffs covering port infrastructure, the facilities necessary for the use of the port and the port services, are a legal responsibility of port authorities under *Article 12* of *The Port and Harbour Law of 1950* (Olukoju 1997). Nevertheless, there are criticisms about the transparency of tariff setting and there are no common regulations for the compilation, publication and revision of port tariffs. In the EU, short-sea shipping is characterised by a lack of transparency of port tariffs (Paixao Casaca & Marlow 2007).

(c) Negotiated port charges and the lump sum port fee: Economic regulation in the port sector, especially in the regulation of port access, enables a port infrastructure owner (usually a port authority) to negotiate access terms and conditions with port access seekers (usually shipping lines). For example, in Australia, economic regulation encompasses the rights of access to infrastructure and the terms of access, including the ability to set prices for the good or the service (Allen Consulting Group 2008). This allows port authorities to negotiate port charges with the port users independently of the government's involvement (Industry Commission 1993). Alternatively, where shipping operators have the right to negotiate with port authorities as in the UK, port tariffs tend to be lower (Goss 1998). As a result, for example as in the South Australian port sector, any price increase in port tariffs may not reflect the actual market price that needs to be paid by the port users (ESCOSA 2009). In the case of landlord ports, private port terminal operators are most likely to negotiate a lump sum fee for all services offered to ships at the berth (ISL 2006). Shipping conferences can also negotiate charges with port operators based on specific contracts (Reynaerts 2010). This reinforces the fact that the willingness of port authorities and port users to negotiate port charges has a direct implication on the port infrastructure tariff practices. Moreover, the increased market power of liner shipping resulting from the dynamism of the shipping industry (mergers and acquisitions) has placed shipping companies in a better bargaining position with seaports. Shipping lines visiting a port on a regular basis negotiate long term contracts with the port, which reduce the ability of the port to charge the cost of the service provided to the user (Strandenes 2004). Thus, it is more likely that the influence of port users is embedded in port tariff practices. Furthermore, as a result of competition, commercialisation, mergers and acquisitions ports need to pay more attention to their efficiency and productivity enhancement strategies (Wilmsmeier 2007). In this regard, providing quality port infrastructure is important in establishing efficient port operation and is also a significant factor along with port tariff levels for shipping lines when selecting a port.

Private sector participation in ports under concessionary agreements has impacted on the design of the port infrastructure tariffs in terms of the level of charge. Port infrastructure tariffs are offered to port users as a composite fee directly received by the port or included in the terminal fee charged by the terminal operator. In the latter case, the port operator also pays a rental to the port infrastructure owner for the use of the infrastructure. Evidence from the Peruvian port sector suggests that the port infrastructure tariffs paid by port users in ports with a single concessionary operator are 22% lower compared to those paid by port users in ports with multi-port concessionaires (Defilippi 2004).

(d) Regulation of port infrastructure tariffs: The regulation of port operation in general aims to foster greater competition. Tariff regulation is given more attention following private sector participation in the port sector in order to establish fair competition. There are different pricing practices in the port sector as a result of market regulation, terms of contracts and the establishment of an independent regulatory agency with a pricing formula for cost recovery (ADB 2000). For instance, ports on the Iberian peninsula are subject to a strict regulatory regime (Castillo-Manzano & Asencio-Flores 2012). This can negatively affect the autonomy of the port authority when tariff setting, In comparison, ports in the UK are self-governing independent seaport organisations with significant freedom to set tariffs (Baird 1999). The autonomy of the port authority in tariff affairs is of prime importance when setting up a market responsive cost based tariff structure for seaport infrastructure and services. Although, as observed by UNCTAD (1975), the degree of autonomy of port authorities has increased only by a limited extent so that, in the EU context, the managerial autonomy over decisions on financial resourcing, investments, and tariff setting in response to changing market requirements remains relatively strict or limited (European Commission 2001). Centralised control of a port and the port authority and the resulting lack of autonomy result in a ports that is unresponsive to competition and cause port authorities to retain their traditional port pricing structures (BTE 1989). In addition, as Tongzon & Sawant (2007) found, among the factors affecting the preferences of the port users when selecting a port, the influence of port charges relative to other factors in the port choice need to be incorporated in the formulation of seaport policy, as port users generally have a maximum price that they are willing to pay for the use of port infrastructure and services. The consultation and/or the influence of port users on port tariff setting is a customary practice found in North American seaports (Dowd & Fleming 1994; Wilder & Pender 1979). This section of the questionnaire examines these factors and circumstances in ports worldwide. Section E2 also covers issues related to port tariff regulation, the autonomy of the port authority in tariff setting and the influence of port users on tariff implementation.

e)Tariff revision: Port tariffs may need to be revised after new port investment (Heggie 1974) and in response to specific factors such as the changing financial position of the port, port facilities and increasing competition from rival ports (UNCTAD 1995a). In such circumstances, the existence of a simple procedure for revising port tariffs results in a more predictable tariff structure (Vincent 1989). However the reasons for port tariff revision are not clearly understood. In many ports tariffs are revised annually and the practice of tariff revision is used as a marketing tool to attract port users (ESCAP 2002; Psaraftis 2005). The process of tariff revision requires interaction by the port authority with external parties such as the government and port users to ensure the welfare of the latter (UNCTAD 1996). However this occurs in various ways as ports follow different practices as observed by OECD (2011). Many ports in West and Central Africa tend to decide tariff levels without considering the traffic volume so as to cover port costs (Harding, Pálsson & Raballand 2007). However the frequency of such revisions and the underlying reasons are not apparent. A further investigation on the factors affecting such practices in world seaports provides a much broader context. The formulation and revision of port tariff structures have evolved traditionally and, in the process, have involved various stakeholders including the governments of ports. As Dowd & Fleming (1994) noted, tariff revision involves internal and external processes that consider the views, opinions and approval of all the stakeholders participating in the port business. However the official tariff formulation, revision and approval process has been over looked and needs further insights in order to understand the presence of any obstacles and their impact on the establishment of efficiency-promoting cost based port infrastructure tariffs. Questions E3.1 to E3.6 of the questionnaire aim to obtain information about existing institutional arrangements for port tariff revision, the processes and decisions made when revising port infrastructure tariffs. Questions in section E3 gather the views of port mangers on the factors concerning the decision of ports to revise their port infrastructure tariffs. Further, to complement the port tariff setting process, based on the views expressed by Frankel (1987) on the contribution and the roles of port managers in each department of the port organisation and, later by Dowd & Fleming (1994) on internal examination, the factors considered for port infrastructure tariff design, formulation and revision are identified by the questions in Section E. Question E4 relates to the level of involvement of the different departments within a port in tariff revision.

The questionnaire also includes two open ended questions (E5.2 and E5.3) to obtain information about infrastructure tariff formulation, revision and approval procedures, and the expectation of the port management concerning the requirement for port tariff-related training and support. The open ended questions were included with the objective of discussing the implications of the research findings on the existing port infrastructure tariff formulation and implementation practices.

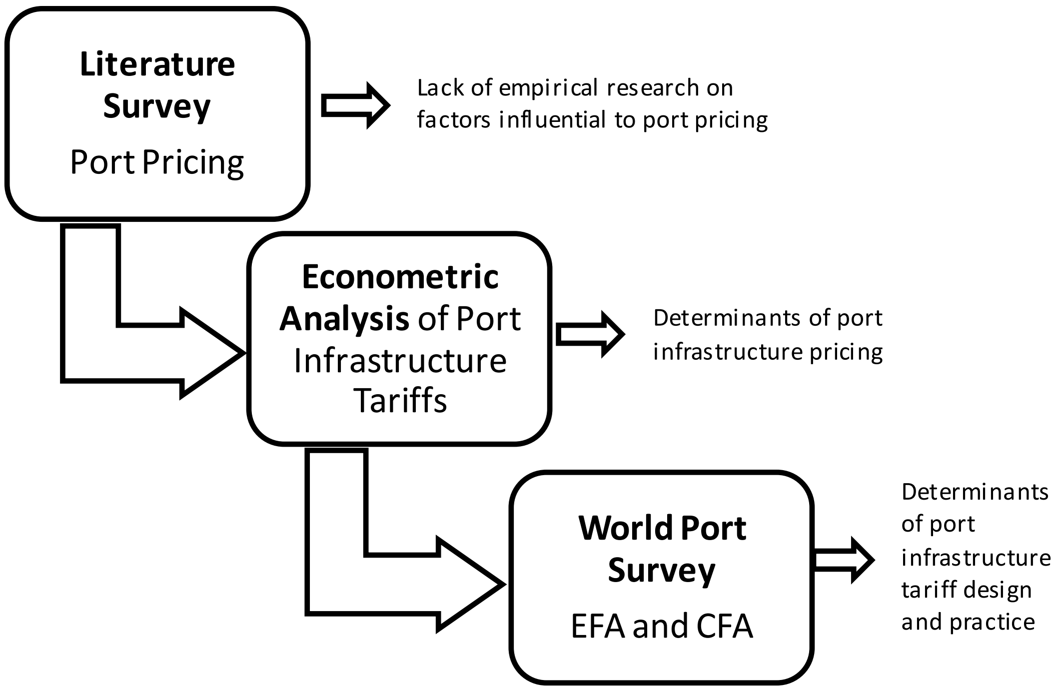
Section F: Profile of the respondent

This section obtained details on the profile of the participating respondents. The information requested included the job title, administrative department, experience in the current position and experience of port tariff affairs. This information helps to confirm the validity and accuracy of the information gathered in the questionnaire.

4.3 RESEARCH DESIGN

This study on port pricing comprises three main parts that support the three-part research cycle as well as the "triangulation" of the research results as illustrated in Figure 4.2. Part 1 is a comprehensive literature survey, conducted to examine port pricing research and its direction, mainly focusing on port infrastructure pricing. Part 2 is an econometric analysis of port infrastructure tariffs (chapter 3) to analyse the extent to which port infrastructure costs explain the level of port infrastructure tariffs while controlling for the effect of other factors such as geographical location, governance model and demand.

Figure 4.2: Research Design and Methods.



Part 3 uses the questionnaire discussed in section 4.3, to conduct a survey of international ports in order to gain an understanding of port infrastructure pricing practices, examine the knowledge of port authorities on conventional port pricing theory, and identify the factors that influence port infrastructure tariff design and practices. The questionnaire asks port managers to provide their views about port infrastructure tariffs and related information concerning their formulation, management, institutional and policy frameworks, and the competitive environment that their port works in. The data are analysed using exploratory factor analysis (EFA) at first in contrast to confirmatory factor analysis (CFA).

4.3.1 SAMPLING FRAMEWORK

Cluster sampling was adopted to select the world ports for the questionnaire survey. Cluster sampling was adopted primarily because it takes into account the geographical distribution of seaports across port regions in the world and allows for the analysis of seaport pricing practices across different regions.

For each port region, North American, South American, African, West European, Mediterranean, South and West Asian, East Asian and Australasian, the contact details of port managers from 450 seaport authorities were chosen from the official web sites of the regional port associations and the *Port and Terminal Guide* (Lloyd's Register-Fairplay Ltd 2011). The contact details of the port, the name of the port, the port authority and its location were also checked against the names of the top 450 ports published by Lloyd's Register-Fairplay and World Port Source website (World Port Source 2013). It was assumed that the management of those ports with the higher throughput (i.e. those in the top 450) would have a greater interest in the organisational set up, the management of the port and the port finances, including port tariffs. Accordingly 450 seaports were included in the sample for the world port survey.

4.3.2 PRETESTING, RECRUITMENT AND RESPONSE RATE

The use of an online (*HTML*) based questionnaire survey method was preferred as recommended by Yun & Trumbo (2000). Participants for the port survey were invited to participate by email to the head of each seaport authority. A consent form for participation was attached together with the access link to the web-based questionnaire developed using the 'Google document' tool.

A pre-test of the questionnaire was conducted in order to assess its reliability and to check for errors and confusion. The pre-test was conducted on 15 participants from academia, research colleagues and colleagues known from the port industry. A mixed method was adopted for the pre-testing of the questionnaire. The questionnaire was also approved by the Ethics Committee of the University of Tasmania (*Appendix III*).

The survey invitations were sent out from the 1st of November to the 31st of December 2013. Of the 450 emails sent inviting participation in the survey, 111 were rejected due to incorrect email addresses or rejection from the email server. Of the remaining 339 emails successfully sent, four port authorities declined to participate and there were 67 complete responses and returns of the questionnaire (a response rate of 20%). During the survey, in order to reduce the non-response bias, suggested by Armstrong and Overton (1977) as the most common type of extrapolation, a successive waves of the questionnaire were generated along with a stimulus, that is a statement that a research report of the survey is provided to the respondent.

4.4 DATA ANALYSIS METHODS

The study employed both quantitative and qualitative methods. Both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were applied in the analysis of factors influential to the practice and design of infrastructure charges in complementary to the regression analysis. The econometric analysis was complemented with EFA and CFA primarily because econometric analysis was unable to capture certain aspect of factors that contribute to the determination of port infrastructure tariffs such as knowledge & its applicability, competition and tariff objective and also triangulate upon port demand, cost recovery factors identified in the regression analysis. Further they could identify factors influential to tariff practice such as tariff policy availability, regulation, transparency concern and stakeholder influence.

The two methods were preferred as two research analysis tools for two main reasons. Firstly, as Cudeck (2000) highlighted, EFA is capable of determining the number of underlying factors important to the research topic, it is able to quantify the extent that each variable is associated with the underlying factors, and is helpful in obtaining information about the nature of the variables from observing which factors contribute to the performance of which variable. Secondly, although EFA has not been extensively applied in port pricing research it has been applied extensively in a broad range of research fields (Winkelmans 1977) and other areas of port research such as: identifying the determinants of port competitiveness and the selection of ports (Yeo, Roe & Dinwoodie 2008); the port selection factors used by shipping lines (Chang, Lee & Tongzon 2008a); the factors affecting port service quality (Kolanović, Skenderović & Zenzerović 2008; Pantouvakis 2006); and the impact of port integration and cooperation on port competitiveness (Chiang & Hwang 2013). Thirdly, CFA is applied not only as an alternative to EFA but also to confirm the results of the EFA, and produce a modal fit for the latent factors.

To derive an appropriate number of factors that best fit the data set Principal Component Analysis (PCA) was applied as preferred over other methods such as: unweighted least squares, generalised least squares, maximum likelihood, principal axis factoring, alpha factoring, and image factoring. Two criteria are used in EFA to determine the suitability of factors:

a. Factors were extracted based on the total variance determined by an eigenvalue greater than 1 (Kaiser Criterion).
b. The numbers of factors above the point of line break in scree plot were considered.

As part of the factor analysis process, the Varimax rotation method was applied in factor extraction, given the fact that there is no widely preferred method of factor rotation and all tend to produce similar results (Abdi 2003; Fabrigar, Wegener, Maccallum & Strahan 1999).

Several statistical tests were conducted before undertaking the EFA:

a. KMO test (Ferguson & Cox 1993).
b. Bartlett's test of Sphericity (Bartlett 1950; Dziuban & Shirkey 1974; Grossman, Nickerson & Freeman 1991; Tobias & Carlson 1969).
c. Correlation coefficient (Dziuban & Shirkey 1974; Grossman, Nickerson & Freeman 1991).

The main objective of these tests was to check whether data is suitable for factor analysis. They showed that the proposed model based on EFA was a best fit to the observed data.

4.5 CHAPTER SUMMARY AND CONCLUSIONS

The objective of this and the subsequent chapters is twofold. Firstly, primary data collected from the survey of international seaports is used to complement and triangulate the secondary data study of port infrastructure tariffs. Secondly, insights are sought into the infrastructure tariff setting process and practices used by international ports, the knowledge and awareness of port authorities of the principles of port infrastructure tariffs and their applications to port tariffs are assessed, and the factors that affect and issues that are involved in port infrastructure tariff design and setting practices are identified.

This chapter presents the methodological framework adopted in the study to answer the research questions and test the research hypotheses. The methodological framework presented in the chapter is based on data and information gathered from a HTML based online questionnaire completed by 67 seaport authorities (equating to a 20% response rate) from different port regions worldwide. The questionnaire was pretested in order to assure its internal validity.

The study employed two methods to understand the factors influencing port infrastructure tariff design and practices. The results of the EFA and CFA conducted on the data gathered by the structured questionnaire of world ports to determine factors influential to port infrastructure tariff design and practices are presented in the next chapter.

CHAPTER 5 : DATA ANALYSIS RESULTS

5.1 INTRODUCTION

As explained in the research methodology (chapter 4) the main focus of this chapter is to examine the current level of knowledge held by port authorities concerning port pricing and its applicability to current infrastructure pricing, and to explore the factors affecting port infrastructure tariff design and setting practices. The chapter is organised as follows: section 5.2 provides essential information on the data set, the profiles of the respondents and the descriptive statistics of the data; section 5.3 presents the results of the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) of port infrastructure tariff design; section 5.4 presents the EFA and CFA results for the port infrastructure tariff setting practices; section 5.5 presents the survey results concerning the current port tariff formulation, revision and approval processes used by worldwide ports; section 5.6 presents the survey results on the perceived need for tariff design training and specific support requirements; and section 5.7 concludes the chapter.

5.2 DESCRIPTIVE STATISTICS

5.2.1 DATA SET

Sixty seven (67) port managers from 67 international seaports in different port regions, all with various ownership types, governance models and administrative structures, responded to the survey, and provided the data presented in this chapter.

Figure 5.1 shows the geographical coverage of the data set (survey respondents came from the countries coloured green in figure 5.1). The geographical coverage of the data includes port authorities from the USA, Canada, Colombia, Trinidad and Tobago, Brazil, Portugal, Italy, Spain, Germany, Scotland, France, Netherlands, Sweden, Norway, Denmark, Croatia, Finland, Estonia, Poland, Lithuania, Cyprus, China, Singapore, Malaysia, Japan, Vietnam, Papua New Guinea (PNG), Australia and New Zealand.

Table 5.1 summarises information on the ownership, governance model, administrative structure and the port region of the ports surveyed.

Figure 5.1: The geographical distribution of the seaport authorities surveyed.

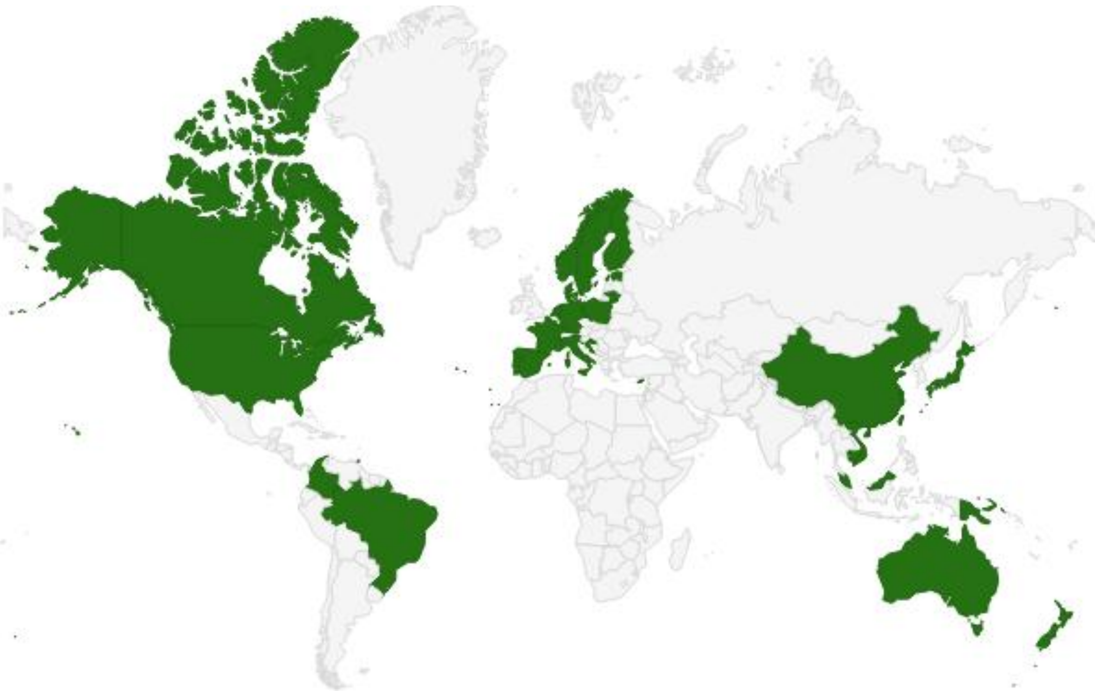


Table 5.1: Ownership, governance, administrative structure and port region of the participating ports.

Ownership	Count	Percentage	Administrative Structure	Count	Percentage
Central Government	24	36%	Statutory Public Port Authority	22	33%
State/Provincial Governemnt	16	24%	Commercialized Port Authority	12	18%
Municipal Governemnt	11	16%	Government Department	6	9%
Local Government	6	9%	Statutory Corporation	2	3%
Public-Private/Foreign Partnershi	1	1%	Government Owned Limited Corporation	7	10%
Private/Foreign Company	2	3%	Public Limited Company	5	7%
Private/Domestic Company	6	9%	Private Limited Company	9	13%
Private-Public/Community Trust	1	1%	Non Profit Public Enterprise	1	1%
Other	0	0%	Municipal Enterprise	2	3%
			Government Trading Enterprise	1	1%
Governance Modal	**Count**	**Percentage**	**Port Region**	**Count**	**Percentage**
Service Port	18	27%	European	28	42%
Tool Port	4	6%	North American	13	19%
Landlord Port	36	54%	South American	3	4%
Privatised Port	6	9%	East Asian	6	9%
Other	1	1%	South East Asian	4	6%
			Australasian	13	19%

Source: Author's calculation based on survey data.

Of the total 67 participating ports, 85% are publicly owned (36% by central government, 24% by state or provincial government, 16% by municipal government and 9% by local government). With regard to the port governance model, 54% conform to the Landlord model, 27% the service model and 9% are privatised. Among the total ports 33% are administered by a statutory public port authority, while 18% are commercial port authorities, 13% are private limited companies and port corporations account for 13%. Interestingly more than 50% of ports in the sample exhibit some level of corporatisation.

Figure 5.2: Distribution of the administrative model across the port governance model.

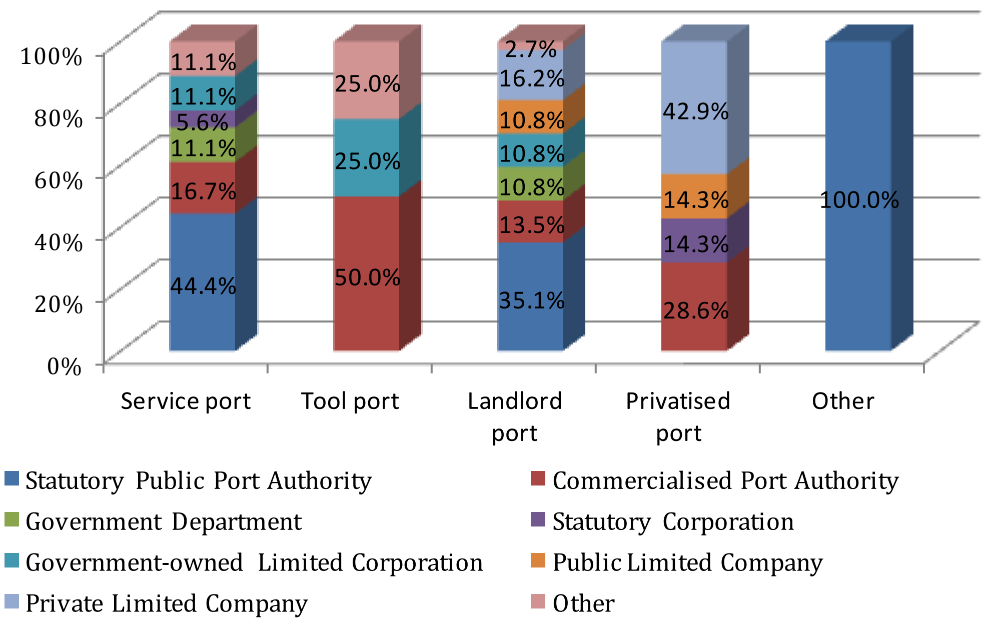


Figure 5.2 illustrates the distribution of administrative models across governance models. The Statutory Public Port Authority is the predominant administrative model for the ports with Service and Landlord governance models (44% and 35% respectively). The Commercialised Port Authority is the predominant administrative model for ports with the Tool governance model (50%), and the second most common administrative model for Privatised ports (29%). The predominant administrative model for Privatised ports is (unsurprisingly) Private Limited Companies (42%). Statutory and Commercialised Port Authorities therefore represent the dominant administrative structures of the participating ports, while the

other administrative models have a fair representation. The majority (42%) of the ports sampled came from the European port region which includes Western Europe, Southern Europe and Northern Europe (the Baltic). The North American and Australasian regions accounted for 19% each, Asia 15% (included East and South East Asia) and there was a very limited response (only 4% of the total) from the South American region.

5.2.2 PROFILE OF THE RESPONDENTS

Figure 5.3 and Table 5.2 present the position and department of the survey participants respectively.

Figure 5.3: Designation of respondents.

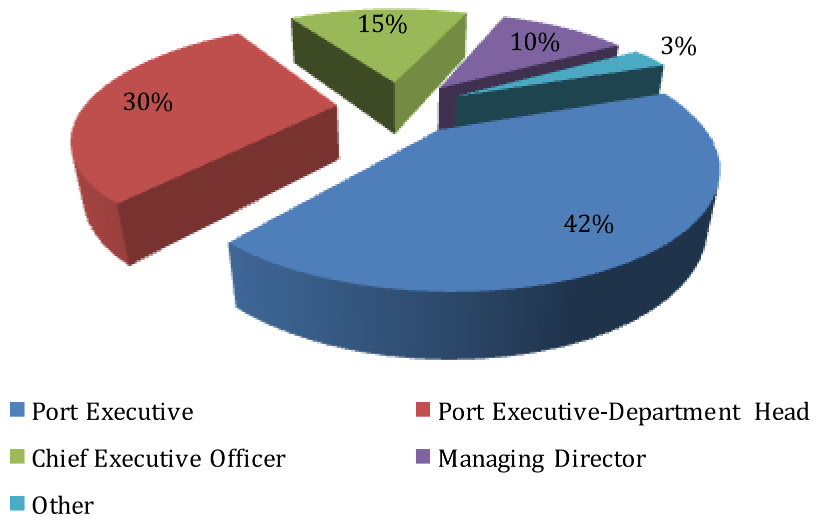


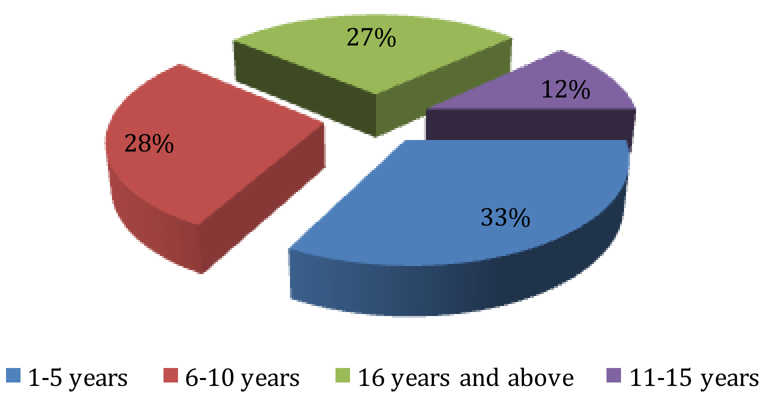
Table 5.2: Distribution of the position and port department of the respondents.

Position	Port Department				
	General Administration	Commercial and Planning	Port Operations	Accounting and Finance	Marketing and Publication
Chief Executive Officer	90%	10%	0%	0%	0%
Managing Director	43%	14%	14%	0%	29%
Port Executive-Department Head	15%	35%	15%	30%	5%
Port Executive	14%	57%	14%	14%	0%
Other	50%	50%	0%	0%	0%
Total	30%	39%	12%	15%	4%

42% of respondents are port executives while 30% are departmental heads. More importantly 15% are chief executive officers and 10% are managing directors. The respondents are mainly attached to their port's general administration or commercial and planning departments, both department accounting for about 69% of the total.

Figure 5.4 shows the number of years of experience related to port tariffs held by the respondents. The data revealed that most of the respondents have a substantial experience in tariff related work with 67% of respondents having 6 years or more experience with regard to port tariffs. More importantly 39% of respondents have 11 years or more experience in port tariff related affairs. This suggests that the responses to the questionnaire came from a sample of port managers holding positions of authority in the ports, and who had many years of experience in port tariff formulation and implementation. Thus the data used in the analysis is valid and reliable and representative of the current port infrastructure tariff dynamics.

Figure 5.4: Experience related to port tariffs.



5.2.3 FACTORS AFFECTING PORT INFRASTRUCTURE TARIFF DESIGN

Table 5.3 reports the feedback by the respondents to the 9-point Likert scale questions on the factors influential to infrastructure tariff design. There are two parts to section B of the questionnaire concerning the knowledge of pricing approaches: questions B1.1 to B1.5 have a scale from 1, 'not at all aware', to 9, 'fully aware' and questions B2.1 to B2.5 have a scale from 1, 'not at all applicable', to 9, 'highly applicable'. For section C, concerning port tariff objectives (C1 to C8) there is a scale from 1, 'not at all agree', to 9 'strongly agree'. Section D regarding the factors affecting port infrastructure tariff design (D1 to D11) has a scale from 1, 'not at all important', to 9, 'highly important'. All the mean values of the responses are significantly higher than the respective midpoint of the Likert scale (5), suggesting that respondents are aware of port pricing models, their applicability and the factors that influence port infrastructure tariff design. The 'Average' (Table 5.3) refers to the average of each respondent's feedback to all questions. The mean value 6.5 implies that the respondents have an overall positive view on port pricing approaches, their applicability and factors affecting port infrastructure design.

Table 5.3: Factors affecting port infrastructure tariff design.

	Variable - Tariff Design	Mean	Std. Deviation	Skewness	Kurtosis
B1.1	Awareness of cost based pricing	7.9	1.4	-1.2	1.2
B1.2	Awareness of market based pricing	7.8	1.5	-1.3	0.9
B1.3	Awareness of social optimal pricing	4.9	2.6	-0.2	-1.1
B1.4	Awareness of discriminatory pricing	5.5	2.7	-0.4	-1.1
B1.5	Awareness of strategic pricing	6.8	2.2	-1.3	1.4
B2.1.	Use of cost based pricing	6.9	2.3	-1.3	1.1
B2.2.	Use of market based pricing	6.9	2.4	-1.3	0.9
B2.3.	Use of social optimal pricing	3.7	2.3	0.4	-0.9
B2.4.	Use of discriminatory pricing	3.4	2.5	0.6	-0.8
B2.5.	Use of strategic pricing	5.7	2.6	-0.7	-0.8
C1	Recovering investment costs	7.4	2.1	-1.5	1.5
C2	Competition with rivals	7.1	2.0	-1.3	1.7
C3	Attracting specific cargo and port users	6.6	2.1	-0.8	-0.1
C4	Increasing port capacity utilisation	6.8	2.2	-1.1	0.6
C5	Covering operation costs	7.1	2.3	-1.2	0.4
C6	Promoting regional economic development	6.5	2.4	-0.7	-0.4
C7	Achieving return on investment	6.0	2.7	-0.7	-0.7
D1	Infrastructure investment cost	7.6	1.7	-1.5	2.8
D2	Infrastrucutre maintenance costs	7.2	2.0	-1.4	1.8
D3	Inflation	6.4	2.2	-0.6	-0.2
D4	Port's financial position	6.6	2.1	-0.9	0.2
D5	Percieved service quality	6.8	2.1	-1.3	1.1
D6	Total financial costs to port users	6.6	2.1	-0.9	0.4
D7	Trade flow	6.7	2.0	-1.2	1.4
D8	Number of ship calls	6.8	2.0	-1.3	1.5
D9	Variability in ship size	6.0	2.3	-0.7	-0.5
D10	Competing port's tariffs	6.8	1.9	-1.3	2.3
D11	Government policy and regulation	6.6	2.3	-1.1	0.4
	Average	***6.5***	***2.2***	***-0.9***	***0.5***

5.2.4 FACTORS AFFECTING PORT INFRASTRUCTURE TARIFFS PRACTICE

Table 5.4 presents the descriptive statistics for the response to the survey questions using the 9-point Likert scale (from 1 being 'strongly disagree' to 9 being 'strongly agree').

Table 5.4: Descriptive statistics of factors affecting port infrastructure tariff setting practices.

	Variable - Tariff Practice	Mean	Std. Deviation	Skewness	Kurtosis
E1.1	Having a committee for tariff formulation	5.8	3.1	-0.5	-1.4
E1.2	Departmental involvement in tariff design	6.2	2.6	-0.7	-0.6
E1.3	Needing government approval for revised tariffs	5.5	3.4	-0.3	-1.7
E1.4	Obtaining feedback from port users	5.9	2.5	-0.6	-0.6
E1.5	Obtaining feedback from port operators	5.5	2.8	-0.4	-1.2
E2.1	Having a policy guideline for tariff design and revision	5.9	2.8	-0.5	-1.1
E2.2	Having a policy on rebates and discounts	6.2	2.9	-0.8	-0.9
E2.3	Publishing tariffs to public	8.3	1.6	-3.4	12.1
E2.4	Having a tariffs regulatory control	5.5	3.3	-0.3	-1.6
E2.5	Offering composite tariff	4.4	2.9	0.2	-1.5
E2.6	Making tariff design and revision public	5.1	3.1	-0.3	-1.5
E2.7	Offering negotiable tariffs	4.8	2.9	0.0	-1.5
E2.8	Adhering to published tariffs	7.3	2.4	-1.6	1.7
E2.9	Offering a lump sum port fee	2.7	2.2	1.3	0.6
E3.1	Revising tariffs after new investment	3.5	2.5	0.6	-0.9
E3.2	Adjusting tariffs with inflation and input cost	6.0	2.9	-0.6	-1.0
E3.3	Revising tariffs as per port demand	4.5	2.4	-0.1	-1.3
E3.4	Revising tariffs as per port’s strategic plan	5.5	2.4	-0.6	-0.6
E3.5	Revising tariffs as per port’s competitive position	5.7	2.3	-0.6	-0.4
E3.6	Revising tariffs as per port's financial position	5.6	2.3	-0.6	-0.4
E4.1	Obtaining inputs from navigation and signalling department	3.9	3.1	0.4	-1.4
E4.2	Obtaining inputs from operation department	6.3	2.5	-1.0	0.0
E4.3	Obtaining inputs from commercial and planning department	7.0	2.4	-1.2	0.6
E4.4	Obtaining inputs from accounting and finance department	6.9	2.2	-1.0	0.6
E4.5	Obtaining inputs from marketing department	5.0	3.0	-0.1	-1.4
E4.6	Obtaining inputs from Engineering department	4.8	2.7	0.0	-1.3
E4.7	Obtaining inputs from human resource department	3.2	2.6	0.8	-0.7
	Average	***5.4***	***2.7***	***-0.4***	***-0.3***

Questions (E1.1 to E4.7) concern the view of the port managers on port infrastructure pricing practices in terms of stakeholder participation in port infrastructure tariffs, the level of transparency, and factors considered during tariff revision. Overall the average of the views of the factors related to port infrastructure tariffs setting practices (5.4) suggests some intermediate level of awareness among respondents to the questions asked by this section of the survey. Most of the mean values of the responses are slightly higher than the respective midpoint (5) of the Likert scale, suggesting that respondents are aware of those factors that affect the port infrastructure tariffs setting practices. However, most mean values are only less than 6, except for a few cases. This indicates that participants seem to be less concerned about the factors that determine port infrastructure pricing setting practices. However, questions E1.2, E2.2, E2.3, E2.8 and E3.2 are the exception, all of which have a mean above six. Table 5.4 shows that the involvement of different departments in tariff design (mean 6.2) is a major way of involving stakeholders in port infrastructure tariff design, followed by obtaining feedback from port users (5.9) and having a committee for tariff formulation (5.8). This suggests that the strongest factors that affect port infrastructure tariff setting practices are the departmental level that is involved in tariff design and revision, the availability of a clear tariff policy for rebates and discounts, making port tariffs publicly available, the requirement for adhering to public port tariffs, and the need to adjust port infrastructure tariffs in accordance to price level and change in input costs.

5.3 FACTOR ANALYSIS: PORT INFRASTRCUTRE DESIGN

This section presents the result of the Exploratory Factor Analysis (EFA) and the Confirmatory Factor Analysis (CFA) to examine the factors influential to port infrastructure tariff design. The EFA presented in section 5.3.1 is used to identify the key underlying factors influential to port infrastructure tariff design. A CFA is then applied to further test the statistical relationships between those variables; this is presented in section 5.3.2.

5.3.1 EXPLORATORY FACTOR ANALYSIS: FACTORS INFLUENTIAL TO PORT INFRASTRUCTURE TARIFF DESIGN

As mentioned in Chapter 4 (research design and methodology), the EFA is applied using Principal Components Analysis (PCA) and the varimax criterion (*Appendix VIII*). Before undertaking the EFA, tests of sampling adequacy and sphericity were also conducted. The sampling adequacy test included the test statistic of the Kaiser–Meyer–Olkin measure of sampling adequacy which is 0.674, significant at the 1% significance level. Similarly Bartlett's Test of Sphericity Chi-Square test statistic for the sample is 976.17, which is significant at the 1% significant level. Thus the null hypothesis that the correlation matrix is an identity matrix is rejected.

Table 5.5 presents the total variance explained by the all the factors associated with the feedback obtained from the survey questions concerning the factors that are important to the design of port infrastructure tariffs. Factors one to five (representing factors influential to port infrastructure design) have the eigenvalues of 5.615, 2.296, 1.822, 1.786 and 1.533 respectively, which are greater than one and explain 72.54% of the total variance. Thus, only these five factors can be retained for further analysis, according to the Kaiser criterion.

Table 5.5: PCA factor analysis of factors influential to port infrastructure tariffs design: Total variance explained (5 Factor Model).

Factors	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	**5.615**	31.193	**31.193**
2	**2.296**	12.757	**43.950**
3	**1.822**	10.124	**54.073**
4	**1.786**	9.923	**63.997**
5	**1.533**	8.517	**72.514**
6	0.811	4.507	77.020
7	0.727	4.040	81.060
8	0.658	3.653	84.714
9	0.584	3.245	87.958
:	:	:	:
18	0.084	0.466	100.000

Extraction method: Principle Component

Table 5.6 reports the rotated, rescaled component matrix for the five factors identified in Table 5.5. The last row of the table shows the Cronbach's Alpha coefficients, used for the reliability test as recommended by Meyers, Gamst & Guarino (2013). The values of the Cronbach's Alpha coefficient for each of 5 factors concerning port infrastructure design are 0.848, 0.803, 0.730, 0.784 and 0.762 respectively. These indicate a relatively high level of reliability (as they are above 0.7[21]) such that the variables identified are more likely measuring a same construct.

As indicated by the loading values (table 5.6), the first factor, 'port demand', is covered in the survey questions D4, D5, D6 and D7 and is associated with the port's financial position (0.792), the total financial cost to the port user (0.787), the

[21] According to Nunnally (1978), a Cronbach's alpha value of 0.7 or higher is an acceptable reliability coefficient.

perceived service quality for users (0.762) and the trade flow of the port (0.696). The higher loadings of the variables suggest that port infrastructure tariff design is influenced by the financial position of the port, the level of total costs to port users, the perceived service quality by port users and the trade flow of the port.

Table 5.6: The rotated, rescaled component matrix[a].

	Factors				
	Port Demand	Knowledge & Applicability	Industry dynamics	Tariff objective	Cost recovery
D4 Port's financial position	**0.792**	0.068	-0.041	0.086	-0.051
D6 Total financial costs to port users	**0.787**	0.217	0.150	0.106	0.273
D5 Perceived service quality	**0.762**	0.061	0.123	0.372	0.103
D7 Trade flow	**0.696**	0.038	0.306	0.368	-0.185
B1.4 Awareness of discriminatory pricing	0.104	0.580	-0.035	0.165	0.117
B1.2 Awareness of market based pricing	-0.017	**0.912**	0.008	0.026	0.073
B1.1 Awareness of cost based pricing	0.081	**0.839**	0.007	0.085	0.077
B2.2 Use of market based pricing	0.391	**0.671**	0.288	-0.118	0.061
B2.1 Use of cost based pricing	0.510	**0.644**	0.009	-0.036	0.281
D10 Tariffs of competing ports	0.289	0.072	**0.853**	0.082	-0.011
C2 Competition with rivals	-0.178	0.068	**0.852**	0.117	0.031
D9 Variability in ship size	0.366	-0.137	**0.622**	-0.097	0.211
C4 Increasing port capacity utilisation	0.240	0.012	0.062	**0.871**	0.121
C6 Promoting regional economic development	0.162	0.068	-0.059	**0.783**	0.185
C3 Attracting specific cargo and port users	0.042	0.247	0.520	**0.669**	0.045
C1 Recovering investment costs	-0.014	0.076	0.019	0.112	**0.902**
C5 Covering operation costs	0.007	0.182	0.093	0.255	**0.739**
D1 Infrastructure investment cost	0.500	0.144	0.072	-0.038	**0.685**
Cronbach's Alpha (Reliability)	**0.848**	**0.803**	**0.730**	**0.784**	**0.762**

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
[a] Rotation converged in 7 iterations.
Kaiser–Meyer–Olkin measure of sampling adequacy is 0.674

The second factor referred to as port pricing 'knowledge and applicability' is covered by questions B1.2, B1.1, B2.2 and B2.1 and is associated with the awareness of market based pricing (0.912), the awareness of cost based pricing (0.839), the use of market based pricing (0.671) and the use of cost based pricing (0.644). Interestingly the awareness of discriminatory pricing (0.580) covered by question B1.4 fails to load above 0.6. These results suggest that the port managers surveyed possess considerable knowledge of cost based, market based and discriminatory pricing approaches and that pricing knowledge is useful when designing port infrastructure tariffs. More importantly cost based and market based pricing approaches are being currently applied in the design of port infrastructure tariffs.

The third factor, 'industry dynamics', includes shipping market and port competition and is covered by questions C2, D10 and D9 of the questionnaire and is associated with the level of competition with rival ports (0.852), the level of tariffs set by rival ports (0.853) and the variability in vessel size (0.622). This suggests that the ports surveyed consider the port's competitive position against its rivals and the characteristics of the port users when designing the infrastructure tariffs. The variability in vessel size is an important consideration when offering discriminatory port infrastructure tariffs as, intuitively, the vessel size is positively correlated with the gross tonnage or the length of the vessel.

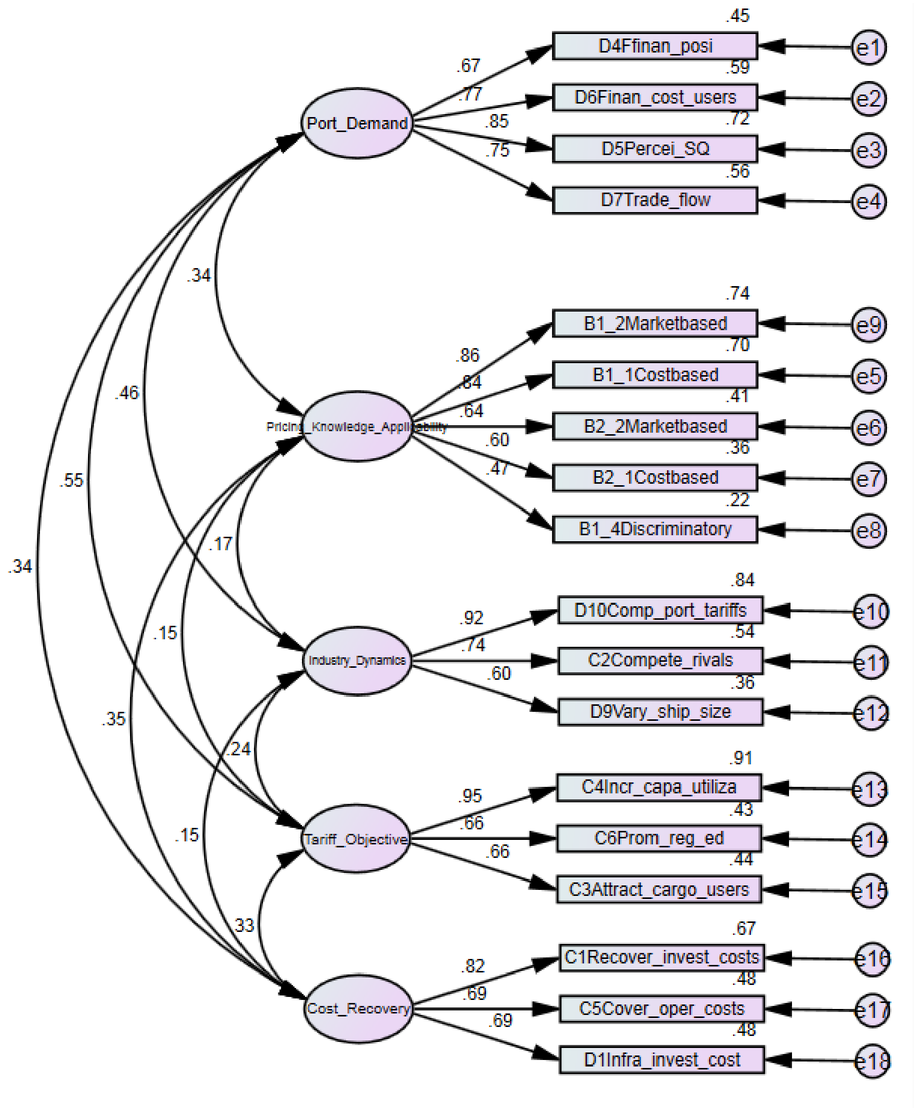
The fourth factor, referred to as 'tariff objective', is covered by questions C4, C6 and C3 and is associated with increasing port capacity utilisation (0.871), promoting regional economic development (0.783) and attracting specific types of cargo and port users (0.669). This suggests that the main objective of infrastructure tariff design is primarily to attract vessels with specific types of cargo that can be best handled by the port, so that the port is not only able to increase the utilisation of port capacity but is also able to promote regional economic development.

The fifth factor, 'cost recovery', is covered in questions C1, C5 and D1 and is associated with the recovery of infrastructure investment costs (0.902), covering operational costs (0.739) and the infrastructure investment cost (0.685). This indicates that contemporary ports are very much concerned about the infrastructure investment cost when designing their tariffs. This is consistent with the fact that ports are highly capital intensive and as such, recovering capital investment costs should be a priority of infrastructure pricing.

5.3.2 CONFIRMATORY FACTOR ANALYSIS: FACTORS INFLUENTIAL TO PORT INFRASTRUCTURE TARIFF DESIGN

Confirmatory Factor Analysis (CFA) is conducted to further analyse and confirm the relationships between the five factors identified in the EFA shown in Table 5.6 (*Appendix IX*). Figure 5.5 shows all the possible relationships between the underlying factors of port infrastructure tariff design with the standard estimates of the regression coefficients respectively. The relationship between variables is indicated by covariance estimates. The results indicate a relationship between port demand and other factors including pricing knowledge and applicability, industry dynamics, tariff objective and cost recovery.

Figure 5.5: Path diagram with standardised estimates for the all relationships.



Further, cost recovery is related to the knowledge and applicability of port pricing and tariff objective. The regression weights reported in Table 5.7 (p.123) strongly indicate that all variables are significant at 1% except variable D10Comp_port_ tariffs (D10: the tariffs of competing ports) which has a negative variance.

The large value of the Chi-square statistic, which is CMIN/DF = 2.428 and the root mean square error of approximation (RMSEA) of 0.147 (Table 5.8) and the Goodness of Fit Index (GFI) of 0.67 and the Adjusted GFI of 0.56 indicate that modification of the model is necessary. The variables with low loadings are first excluded, and based on the values of standardised residual covariance variables those with higher residual covariances (above 0.4) are excluded in repeated trials.

Table 5.7: CFA analysis results for the model shown in Figure 5.5.

Variable		Factors	Estimate	S.E.	C.R.	P
D4 Port's financial position	←	Port Demand	1			***
D6 Total financial costs to port users	←	Port Demand	1.184	0.222	5.331	***
D5 Perceived service quality	←	Port Demand	1.315	0.230	5.706	***
D7 Trade flow	←	Port Demand	1.096	0.210	5.212	***
B1.1 Awareness of cost based pricing	←	Pricing Knowledge & Applicability	1			***
B2.1 Use of market based pricing	←	Pricing Knowledge & Applicability	1.326	0.245	5.408	***
B1.2 Use of cost based pricing	←	Pricing Knowledge & Applicability	1.209	0.241	5.006	***
B2.4 Awareness of discriminatory pricing	←	Pricing Knowledge & Applicability	1.125	0.300	3.748	***
B1.4 Awareness of market based pricing	←	Pricing Knowledge & Applicability	1.144	0.155	7.385	***
D10 Competing ports' tariffs	←	Industry Dynamics	1			***
C2 Competition with rivals	←	Industry Dynamics	0.937	0.145	5.107	***
D9 Variability in ship size	←	Industry Dynamics	0.837	0.165	5.067	***
C4 Port capacity utilization	←	Tariff Objective	1			***
C6 Regional economic development	←	Tariff Objective	0.742	0.141	5.254	***
C3 Attracting cargo and port users	←	Tariff Objective	0.676	0.128	5.282	***
C1 Covering investment costs	←	Cost Recovery	1			***
C5 Covering operation costs	←	Cost Recovery	0.919	0.193	4.757	***
D1 Infrastructure investment cost	←	Cost Recovery	0.664	0.140	4.739	***

*** 0.00 = significant at 1% significance level

Table 5.8: Model Fit-Factors influential to port infrastructure tariff design.

Chi-square statistic (CMIN)

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	45	305.961	126	0.314	2.428
Saturated model	171	0.000	0		
Independence model	18	748.345	153	0.000	4.891

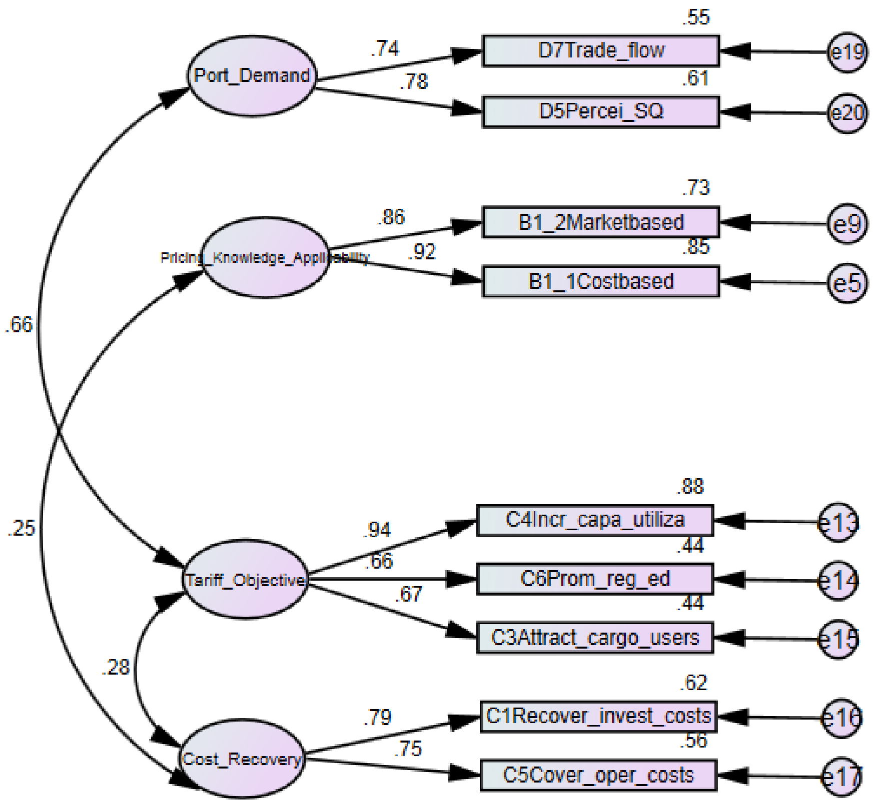
Root Mean Square Error of Approximation (RMSEA)

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.142	0.126	0.168	0.000
Independence model	0.243	0.226	0.260	0.000

Figure 5.6 shows that the CFA results strongly indicate a significant relationship between port demand and the tariff objective and some degree of relationship

between port pricing knowledge and cost recovery, and between the tariff objective and cost recovery.

Figure 5.6: Path Diagram with Standardised Estimates for the Significant Relationships.



As indicated in Table 5.9, all the variables in this model are significant. Furthermore, although their values remain just outside the desirable ranges as shown in Table 5.10, both the Chi-square statistic (CMIN/DF) and the root mean square error of approximation RMSEA have improved significantly with their values being 1.114 and 0.042 respectively. PCLOSE related to RMSEA is 0.526. Given that the RMSEA point estimate < 0.05 and the probability associated with the test of close is > 0.50, it can be concluded that the resultant model fits the data well. Further the Goodness of Fit Index and Adjusted GFI have significantly improved being their values 0.920 and 0.856 respectively indicating an acceptable model fit (Appendix XI, Model fit summary).

Table 5.9: CFA analysis results for the Figure 5.6 model.

Variables		Factors	Estimate	S.E.	C.R.	P
B1.1 Cost based pricing knowledge	←	Pricing Knowledge	1			
B1.2 Market based pricing knowledge	←	Pricing Knowledge	1.04	0.41	2.49	0.01
C4 Port capacity utilisation	←	Tariff Objective	1			
C6 Regional economic development	←	Tariff Objective	0.76	0.14	5.43	***
C3 Attracting cargo and port users	←	Tariff Objective	0.69	0.12	5.48	***
C1 Recovering investment cost	←	Cost Recovery	0.90	0.10	4.72	***
C5 Covering operational cost	←	Cost Recovery	1			
D7 Trade flow	←	Port Demand	0.90	0.20	4.36	***
D5 Perceived service quality	←	Port Demand	1			

*** = significance

Table 5.10: Model Fit Summary for Figure 5.6: CFA on factors influential to port infrastructure tariff design.

Chi-square statistic (CMIN)

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	20	27.857	20	0.314	1.114
Saturated model	45	.000	0		
Independence model	9	246.445	36	0.000	6.846

Root Mean Square Error of Approximation (RMSEA)

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.042	0.000	0.110	0.526
Independence model	0.298	0.263	0.333	0.000

This result suggests that, in contrast to the EFA output of five factors, the CFA produces a model of four factors that are influential in port infrastructure tariff design: port demand, port pricing knowledge, the tariff objective and the cost recovery consideration. The dynamics of the port and shipping industry, such as port competition and variability in ship size, do not influence port infrastructure tariff design. Although ports possess substantial knowledge on cost based and market based pricing approaches, their applicability is rather limited.

5.4 FACTOR ANALYSIS: PORT INFRASTRUCTURE PRICING PRACTICES

5.4.1 EXPLORATORY FACTOR ANALYSIS: FACTORS INFLUENTIAL TO PORT INFRASTRUCTURE TARIFF SETTING PRACTICES

Similar to the previous section, a EFA is conducted to analyse the factors influencing port infrastructure tariff setting practices based on data collected from the questionnaire sections E1 to E4 (*Appendix X*). Again, before undertaking the EFA, a test for sampling adequacy and sphericity was conducted. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy for items E1 to E4 was 0.683, which is above the suggested minimum. Similarly Bartlett's Test of Sphericity Chi-Square test statistics for items was 877.45, which is significant at the 1% significant level. Thus the null hypothesis that the correlation matrix is an identity matrix is rejected. Table 5.11 and Table 5.12 show the results of the EFA concerning the factors affecting the port infrastructure tariff setting practices.

Table 5.11: Factors influential to port infrastructure tariff setting practices.

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	**3.878**	27.698	**27.698**
2	**2.384**	17.027	**44.725**
3	**1.592**	11.373	**56.098**
4	**1.235**	8.824	**64.922**
5	0.921	6.578	71.500
6	0.753	5.377	76.877
7	0.699	4.990	81.867
:	:	:	:
13	0.192	1.372	99.060
14	0.132	0.940	100.000

Factors one to four (Table 5.11), representing port infrastructure tariff policy, tariff regulation, transparency and stakeholder participation in port infrastructure tariffs respectively, have the initial eigenvalues of 3.878, 2.384 1.592 and 1.235, which are larger than 1 (Table 5.11). These factors explain 64.922% of the total variance of the variables. Thus, according to the Kaiser criterion, these factors can be retained for further analysis.

Table 5.12 reports the rotated, rescaled component matrix for these factors. The values of the Cronbach's Alpha coefficient for the variables in each of the four factors identified as influencing port infrastructure tariff setting practices are 0.807, 0.670, 0.678 and 0.873 respectively.

Table 5.12: Rotated, rescaled factor matrix.

	Factors			
	Tariff policy	Tariff Regulation	Transparency	Stakeholder participation
E3.5 Revising tariffs as per port's competitive position	**0.772**	-0.052	0.213	0.051
E2.1 Having a policy guideline for tariff design and revision	**0.723**	0.454	0.000	-0.147
E2.2 Having a policy on rebates and discounts	**0.707**	-0.033	0.219	0.008
E3.4 Revising tariffs as per port's strategic plan	**0.706**	0.207	-0.065	0.029
E4.3 Obtaining inputs from commercial and planning dept.	**0.684**	0.128	0.134	-0.015
E3.2 Adjusting tariffs with inflation and input cost	**0.635**	-0.222	0.063	0.144
E2.4 Having a tariff regulatory control	0.067	**0.806**	0.190	0.139
E1.3 Needing government approval for revised tariffs	-0.042	**0.793**	0.113	0.123
E2.8 Adhering to published tariffs	0.242	**0.556**	-0.267	0.339
E2.5 Offering a composite tariff	0.223	-0.015	**0.785**	-0.093
E2.7 Offering negotiable tariffs	0.277	-0.013	**0.719**	0.213
E2.9 Offering a lump sum port fee	-0.039	0.341	**0.704**	0.184
E1.4 Obtaining feedback from port users	0.032	0.159	0.014	**0.926**
E1.5 Obtaining feedback from port operators	0.007	0.199	0.236	**0.870**
Reliability - Cronbach's Alpha	0.807	0.670	0.678	0.873

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalisation
a. Rotation converged in 5 iterations
Kaiser–Meyer–Olkin measure of sampling adequacy is 0.683

The first factor, 'port infrastructure tariff policy', is associated with six variables: tariff revision as per the port's competitive position (loading value 0.772), availability of a policy guideline for tariff design and revision (0.723), availability of a clear policy on tariff rebates and discounts (0.707), tariff revision as per port's strategic plan (0.706), obtaining inputs from commercial and planning department participation in port tariff design (0.684) and adjusting tariffs with inflation and input cost (0.635).

The second factor, 'tariff regulation', is associated with two variables: having regulatory control of the port tariff (0.806) and the need for government approval for tariff revision (0.793). However the question on tariff transparency (adhering to published tariffs) has the loading of 0.556 and cannot be included in the tariff regulation factor.

The third factor, 'transparency' is associated with three variables: tariff bundling (0.785), tariff negotiation (0.719) and the lump sum payment option (0.704). The fourth factor, 'stakeholder participation', is associated with two variables concerned with obtaining feedback from port users of revised tariffs (0.926) and feedback from terminal operators of proposed tariff revision (0.870).

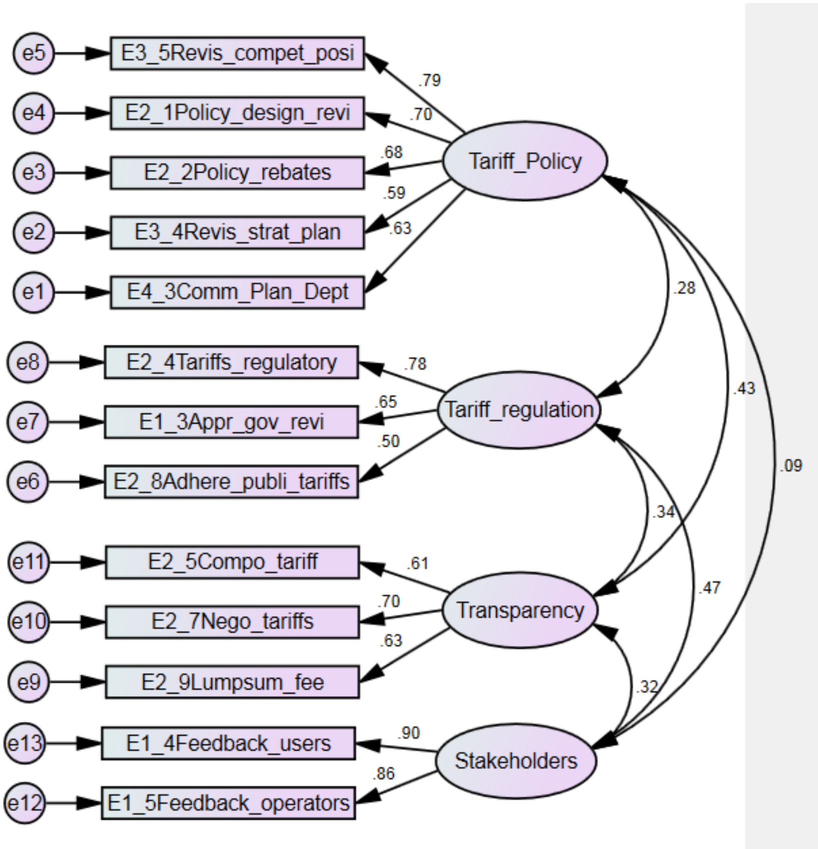
The results of the EFA suggest that ports follow specific tariff policies when they revise their tariffs. A number of factors may influence their tariffs and hence the need to revise their tariffs. These include the port's competitive position, strategic plans, rebate policy, inflation and input costs. The tariff setting and revision process involves the commercial and planning departments of the port as well as stakeholders including port users, competition regulatory authorities and governments.

5.4.2 CONFIRMATORY FACTOR ANALYSIS: FACTORS INFLUENTIAL TO PORT INFRASTRUCTURE TARIFF SETTING PRACTICES

A CFA was conducted in order to further evaluate the four underlying factors identified by the EFA and their relationships (*Appendix XI*). Figure 5.7 (page 129) shows all the possible relationships between the underlying factors of port infrastructure tariff setting practices and their associated variables with the standard estimates of the regression coefficients respectively.

The relationships between the variables as indicated by the covariance estimates indicate a relationship between tariff policy and other two factors including tariff regulation and transparency. Further, tariff regulation is related to transparency and stakeholder participation, and transparency is related to stakeholder participation.

Figure 5.7: Path diagram with standardised estimates for the all relationships (model fit).



The regression results shown in Table 5.13 (p.130) strongly indicate that all relationships are significant at 1%. However, the Chi-square statistic CMIN/DF is 1.696, the root mean square error of approximation (RMSEA) is 0.103 and PCLOSE is 0.011 (Table 5.14, p.129), and a modification of the model is necessary. Variables with low loadings are excluded first and, based on the values of standardised residual covariances; variables with higher residual covariances (above 0.4) are excluded subsequently.

Table 5.13: CFA analysis results for the Figure 7 Model.

Variable		Factors	Estimate	S.E.	C.R.	P
E4.3 Obtaining inputs from commercial and planning dept.	←	Tariff Policy	1			
E3.4 Revising tariffs as per port's strategic plan	←	Tariff Policy	0.920	0.235	3.906	***
E2.2 Having a policy on rebates and discounts	←	Tariff Policy	1.291	0.297	4.346	***
E2.1 Having a policy guideline for tariff design and revision	←	Tariff Policy	1.303	0.294	4.436	***
E3.5 Revising tariffs as per port's competitive position	←	Tariff Policy	1.194	0.252	4.737	***
E2.8 Adhering to published tariffs	←	Tariff Regulation	1			
E1.3 Needing government approval for revised tariffs	←	Tariff Regulation	1.864	0.587	3.177	***
E2.4 Having a tariff regulatory control	←	Tariff Regulation	2.157	0.676	3.193	***
E2.9 Offering a lump sum port fee	←	Transparency	1			
E2.7 Offering negotiable tariffs	←	Transparency	1.438	0.408	3.529	***
E2.5 Offering a composite tariff	←	Transparency	1.244	0.365	3.404	***
E1.5 Obtaining feedback from port operators	←	Stakeholders	1			
E1.4 Obtaining feedback from port users	←	Stakeholders	1.344	0.565	3.804	***

*** = significant at 1% significance level

Table 5.14: Model Fit Summary for Figure 5.7: CFA on factors influential to port infrastructure tariff setting practices.

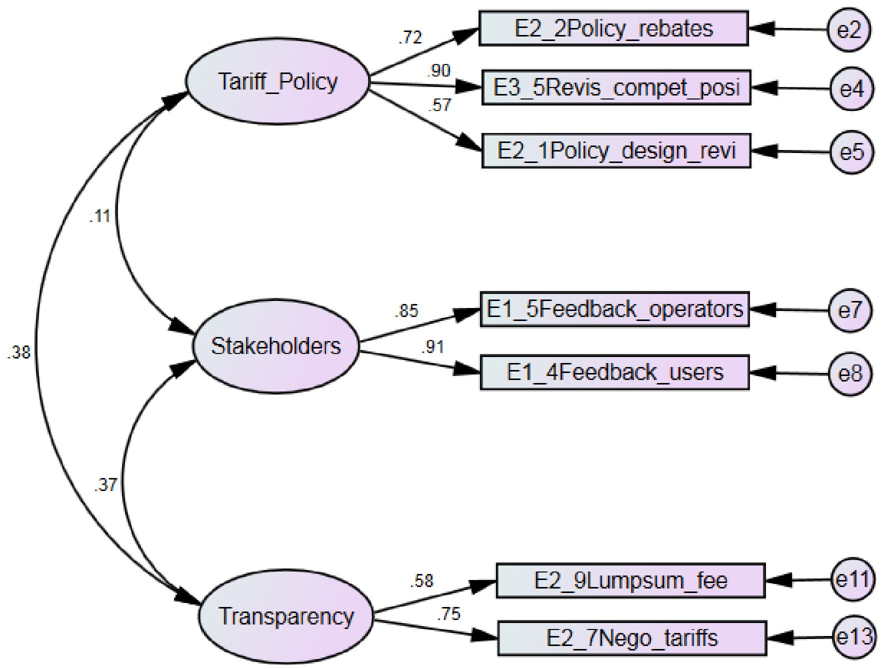
Chi-square statistic (CMIN)

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	31	101.736	60	0.001	1.696
Saturated model	91	0.000	0		
Independence model	13	348.924	78	0.000	4.473

Root Mean Square Error of Approximation (RMSEA)

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.103	0.067	0.136	0.011
Independence model	0.229	0.205	0.254	0.000

Figure 5.8: Path Diagram with Standardised Estimates for the Significant Relationships (model fit).



The CFA results (Figure 5.8) indicate significant relationships between transparency and tariff policy, and transparency and stakeholder participation, and some degree of relationship between tariff policy and stakeholder participation. The tariff regulation factor is not significant as all of its variables that were significant under the EFA are excluded by the CFA.

The result of the CFA reveals that the underlying factors influential to port infrastructure tariff setting practices are port tariff policy, stakeholder participation and transparency. Table 5.15 shows that all the variables included in this model are significant.

Table 5.15: CFA analysis results for the Figure 5.8 model.

Variables		Factors	Estimate	S.E.	C.R.	P
E2.2 Having a policy on rebates and discounts	←	Tariff Policy	1			
E3.5 Revising tariffs as per port's competitive position	←	Tariff Policy	1.004	0.219	4.576	***
E2.1 Having a policy guideline for tariff design and revision	←	Tariff Policy	0.783	0.186	4.219	***
E1.5 Obtaining feedback from port operators	←	Stakeholders	1			
E1.4 Obtaining feedback from port users	←	Stakeholders	1.244	0.365	3.894	***
E2.7 Offering negotiable tariffs	←	Transparency	1.675	0.727	2.304	0.02
E2.9 Offering a lump sum port fee	←	Transparency	1			

*** = significant at 1% significance level

Table 5.16 indicates that the CMIN/DF value has improved significantly to 0.834. The RMSEA value for the 3 factor model is 0.000, with the 90% confidence interval ranging from 0.000 to 0.108 and the p value (PCLOSE) related to RMSEA indicates a closeness of fit equal to 0.740. The 90% confidence interval indicates that the true RMSEA value in the population falls between the lower (0.000) and upper bounds (0.108).

Table 5.16: Model Fit Summary for figure 5.8: CFA on factors influential to port infrastructure tariff setting practices.

Chi-square statistic (CMIN)

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	16	10.010	12	0.615	0.834
Saturated model	28	0.000	0		
Independence model	7	151.899	21	0.000	7.233

Root Mean Square Error of Approximation (RMSEA)

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	0.000	0.000	0.108	0.740
Independence model	0.307	0.262	0.354	0.000

Given a RMSEA point estimate less than 0.05 and the probability associated with the test of close greater than 0.50, and also the Goodness of Fit Index and Adjusted GFI being their values .961 .909 respectively, it can be concluded that the resulting model has a good fit. Therefore, it can be confirmed that the tariff policy factor is related to the port's guideline for tariff design and revision, the revision of tariffs as per the port's competitive position, and the presence of a policy on rebates and discounts. The stakeholder participation factor is related to practices such as obtaining feedback from port operators and users, while the transparency factor is related to tariff setting practices such as offering ships negotiable tariffs and lump sum payment options.

This result suggests that, in contrast to the EFA output, the CFA produces a model of three factors that are influential on port infrastructure tariff setting practices: port tariff policy, stakeholder participation and transparency. The tariff regulatory requirements including government approval and adhering to published tariffs do not have much influence on infrastructure tariff setting practices. More importantly although ports have specific departments such as commercial and port planning departments that are responsible for tariff setting, obtaining input solely from these departments is not sufficient for tariff revision. In addition, tariff revision as per the port's strategic plan should not be the only basis for tariff revision.

5.5 THE PORT TARIFF FORMULATION, REVISION AND APPROVAL PROCESS[22]

As mentioned in section 1.3, third objective of the study is to *assess the determinants of port infrastructure tariff design and practices in world seaports and discuss the implications for port management and policy makers.* Thus open-ended question section is to investigate whether port follow a structured procedure to design, revise and implement tariffs. This section presents the results of the two open-ended questions included as part of the questionnaire to international seaport managers (*Appendix II*). The first open-ended question concerned the survey port's tariff formulation, revision and the tariff approval process, and the second one concerned the training needs for port managers in port tariff design. The tariff setting practices that are influenced by port tariff policy include: having a policy guideline for tariff

[22] An extract of responses to the open ended questions E5.2 and E5.3 on tariff formulation, revision and approval process of the respondent's port and the training needs for port managers in port tariff designing is provided in Appendix II.

design and revision; revising tariffs based on the port’s competitive position and strategic plan; obtaining input from the port's commercial and planning departments; and having a policy on rebates and discounts. A content analysis of the responses to the open-ended question on port tariff formulation and the revision procedure reveals the role of a port committee or a board of directors and the existence of several different approaches to tariff formulation, revision and approval (summarised in Table 5.17).

Table 5.17: Port tariff revision and approval: participants and the process.

Port Administrative Model	Internal body	Reviewers	Government Rep	Government Approval	Feedback	Process
Municipal port enterprise	Port committee/ board	Commercial section	Council representative	-	-	Internal departmental review → internal committee→ implement
Statutory port authority	Board of directors	Internal staff/CEO/	Ministry representative	Ministry/ Regulatory approval	Port users	Internal review → Board of directors → ministry recommendation → regulatory approval → implement
Commercialised port authority	Board of directors	Port management	-	Ministry approval	Port users	Internal review → Ministry approval→ implement
Port department	Internal committee	Port financial section/CEO	-	Ministry approval		Internal review → Ministry approval → implement
Port corporation	Board of directors	Each port department	-	Ministry approval	Port users	Internal review → Board of directors → customer feedback → implement
Private limited company	Board of directors	Internal review/ external consultants/ CEO	-	-	-	Consultant → CEO → Board of directors →implement

Source: compiled by author based on survey data

In ports owned by municipal councils port tariffs are subject to approval by a port committee, usually the council of administration of the port authority. The council is made of representatives of the public administrators and of the port operators. The analysis of responses from port managers revealed that 60% of port authorities have a committee responsible for tariff formulation, review and revision. They also stated that the technical aspects of port tariffs are handled by their port's commercial division.

The following summarises the different procedures for tariff formulation and revision used by the municipal ports surveyed:

i. The existing tariff structure, including both tariff items and rates, is used for tariff revision. The revision is proposed by the Business & Operations Department based on the market and certain other conditions for consideration and approval by a committee of selected members chaired by the Chief Executive Officer (CEO) of the port. Revision is usually on an annual basis but sometimes is on-demand (when required).
ii. Tariff change initiatives are first suggested internally by the department that owns the tariff then, after consultation with port users, the proposed fees/changes are internally approved by the Executive Committee or the Board, upon which a notice of the fee/change is published before the fee comes into effect.

A port tariff committee works with port operators to review tariffs based on the Consumer Price Index and in the event of a new port investment, identifies new port users and proposes incentives for port users.

Statutory public port authorities established under the service and landlord models represent 33% of the ports sampled. The procedures for tariff formulation and revision used by the statutory public port authorities surveyed are summarised below:

i. Port tariffs are annually reviewed by senior staff responsible for tariffs with the CEO and with the endorsement of the CEO of the port. The revised tariffs are then forwarded to the Board of Directors for final approval.

ii. The port tariffs are agreed by a Port Committee that is the administrative council of the port authority. The council is made of representatives of the public administrators and the port operators.
iii. Port tariffs are revised annually to adjust for the inflation rate. After discussions between the Executive Board and the port community association, revised tariffs are submitted to the government (at the ministerial level) for approval.
iv. Basic tariffs are approved by the government and the port has a limited authority to change, depending to its strategy and financial situation.
v. The tariff revision process is based on the strategic plan and objectives, and is reviewed by a state board responsible for public sector administration.
vi. Tariff revision considers the regional trends in tariffs, the tariffs of competing ports and the infrastructure costs. Tariffs must be approved by a board of directors and/or a commissioner and a supervisory board of the port.

The data collected also revealed the different steps that ports under the statutory port authority administrative model take when revising and formulating port tariffs. These are:

i. Conduct a review of the prevailing rates (domestic and regional) for similar services offered at competing ports. This includes a review of the port's competitive position and the behaviour of competing ports.
ii. Review the financial conditions of the port, and any wages and salary increases that are a result of negotiations with employees, which increase the operational costs.
iii. Strive to engage in the settlement of labour contracts with labour unions in order to reduce operational costs through higher efficiency, which will impact on shipping lines costs.
iv. Account for the maintenance of and acquisition of new equipment and infrastructure.
v. Ensure that the port remains competitive by using a conservative increase in tariffs.
vi. Forward revised tariffs for approval. The approval process would include board approval from the port and ministerial approval on behalf of the government.

The information provided by commercialised port authorities on the tariff formulation revision and approval procedure indicates a procedure similar to that adopted by statutory port authorities. The involvement of the Board of Directors of the port and the relevant ministry for tariff approval is common to both administrative models. While tariffs are reviewed and revised annually by port management, it involves a process of engagement with all port stakeholders. Port users are informed of the revised tariff rates prior to implementation for comment and suggestions. Interestingly, tariffs are revised annually with regards to the rate of return objective and cost increases including finance costs, wages and other supplies of the port. The changes to pricing are usually formulated and documented in the port's strategic plan.

Survey information provided by Government Department port authorities indicates the tariff formulation revision and approval procedure involves a public policy prescription adopted by a public department or a bureau. Since port infrastructure tariffs, port, berth and light dues, are charged for the use of public marine infrastructure and facilities, fees levied are based on the schedules contained in legal provisions and thus, revision to those schedules is a legislative procedure. While tariff revision is carried out annually based on cost, the process involves approvals by the CEO of the port and the minister. Port tariffs are internally reviewed and adjusted by the financial department of the port with technical inputs given by respective departments such as the Marine Department and Port Works Division of the Civil Engineering and Development Department.

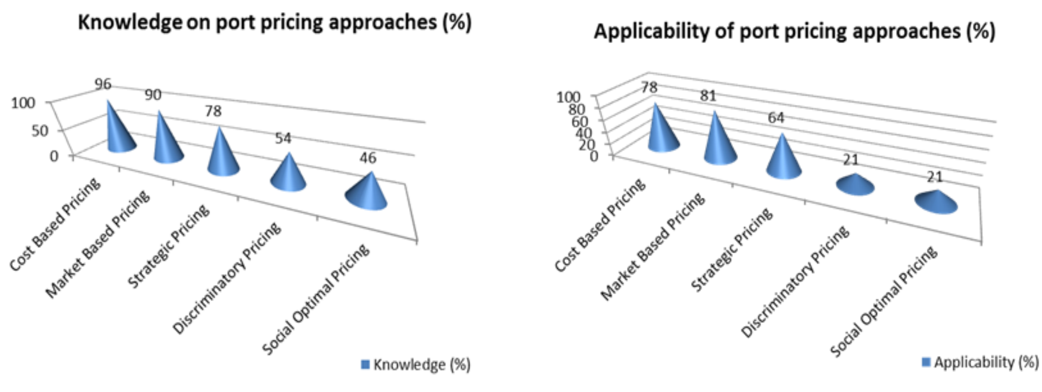
For Port Corporations including both statutory and limited corporations, port tariffs are reviewed regularly to ensure currency using financial reports, market information and strategic planning. Once reviews are completed, tariffs are set. After the approval of the Board of directors, tariffs are published to port customers. Unlike a port under a port authority or government department, there is no or much less government or regulatory involvement in the tariff approval process. The tariff revision process is carried out internally. The existing tariff structure is revised by each department of the port based on the market and certain other conditions for consideration and approval by a committee chaired by the CEO. In order to increase the transparency, revised port charges are notified to port users with information concerning the reasons for revision.

The tariff revision process of the more corporatised port administrative models such as private limited company ports involves the annual revision of tariffs to allow for growth in infrastructure, customer requirements and the need for a return to shareholders. In the revision process, port management often employs external consultants in the absence of internal expertise. As commonly seen in other port administrative models, the pricing of tariffs is led by the CEO or Financial Officer. The results are submitted to the Board of Directors of the port for approval. More importantly tariff adjustment takes into account the Consumer Price Index and other input cost changes.

5.6 TRAINING AND SUPPORT REQUIREMENT FOR TARIFF FORMULATION

Port pricing has been viewed as an archaic issue by many researchers due to its historical evolution and the heterogeneity of non-standardised business practices across ports. There is limited research on the need for technical training and support to port staff in tariff setting. The capability of seaport authorities in port tariff design and revision is variable. There is no clear evidence whether seaport authorities possess substantial knowledge on port pricing theory and principles and seaport authorities apply them in port infrastructure tariff design. The survey provides the views of port mangers on the training needs of port authorities in tariff design. Figure 5.9 summarises the responses of port managers concerning the knowledge and applicability of port pricing approaches.

Figure 5.9: The knowledge and applicability of port pricing approaches: The view of port managers.



The survey data of ports revealed several aspects of technical training and support that ports think they might require in designing port infrastructure tariffs. This section briefly presents views of port mangers on the training requirement for port tariffs designing

As shown in Figure 5.9, 96% and 90 % of port managers agree that they are aware of the cost based and market pricing approaches respectively which is also confirmed by the EFA and CFA results. However only 78% of them agree that cost based pricing has been applied to tariff design while only 81% agree that market based pricing is used. 78% are aware of the strategic pricing approach while only 64 % agree that this has been applied in practice. 50% of port managers are aware of the discriminatory and social optimal pricing approaches while only 20% agree that this approach has actually been applied in practice. The survey also revealed several aspects of technical training and support that port managers thought that they might require concerning the design of port infrastructure tariffs. The following aspects of training and support were highlighted by respondents:

i. Any training needs to establish a clear documented policy for the formulation of tariffs and the implementation of a pricing policy to achieve other objectives including investment recovery and maintenance.
ii. Training related to developing a ‘Pricing Estimator’ would be useful.
iii. Training is required to establish a more accurate approach to cost based prices for port services.
iv. Training and support through international seminars with best-practice in port pricing and the theory behind this best-practice.
v. Support requested for some management levels in the general formulation, strategy and good practices for high port competitiveness in port tariff design and revision.
vi. Support to conduct a market survey of the infrastructure tariffs of competitive ports.
vii. Support to develop a good data base, analytical tools, an experienced workforce, knowledge about other ports and the environment is required
viii. Support in policy advice related to port tariff setting to meet the needs of the shareholder (government).

5.7 CONCLUSION

This chapter presents the results of a survey of international seaports on various aspects related to their infrastructure tariff design process and setting practices. Data collected from the survey were applied using both EFA and CFA to identify the underlying factors influencing port infrastructure tariff design and setting practices and to evaluate their relationship.

The survey received the responses of 67 seaports from various regions in the world including North America, Europe, Asia and Australasia. The result of the EFA indicates that the factors affecting port infrastructure design are port demand, pricing knowledge and applicability, competition and vessel size, the tariff setting objective and costs. The study has also found the underlying factors influential to port infrastructure tariff setting practices: government policy, stakeholder participation in tariff revision and the level of transparency.

The analysis of open-ended questions on the procedure of infrastructure tariff design, revision and approval, and the need for specific training requirements for tariff design shows that port authorities follow different processes in tariff design, revision and approval. In addition, various parties are involved in the approval process depending on the administrative structure of the port. Further training and support requirement that ports need in tariff designing and revision shows that the existing knowledge on port pricing and what is required. Further it is also another evidence to suggest ports, although they have some knowledge in port pricing, there is lack of application of it.

CHAPTER 6 : DISCUSSION OF THE RESULTS & IMPLICATIONS OF THE ANALYSIS

6.1 INTRODUCTION

This chapter[23] discusses the results of the analysis presented in chapter 5 and provides implications for port management, policy makers and stakeholders. Importantly this chapter also reviews the research project's findings and whether the project has addressed the research questions and hypotheses that were presented in chapter 4.

The chapter is organised as follows. Section 6.2 discusses the analysis results concerning the factors influential to port infrastructure tariff design. Section 6.3 discusses the analysis results concerning port infrastructure tariff setting practices, the tariff revision and approval process, and the knowledge by port authorities of port pricing approaches and their applicability. Section 6.4 compares the results of the regression estimation of infrastructure tariff determinants (chapter 3) and the results of the EFA and CFA on the factors influential to port infrastructure tariff design with the view of triangulating the research findings. Section 6.5 addresses the research questions and hypotheses presented in chapter 4 and section 6.6 concludes the chapter.

6.2 FACTORS INFLUENTIAL TO PORT INFRASTRCUTRE TARIFF DESIGN

An analysis of the results presented in chapter 5 reveals various underlying (latent) factors influential to port infrastructure design. The EFA identified five factors influential to infrastructure tariff design, four of which have been analysed and confirmed by the CFA. These factors are presented in Table 6.1 (overleaf).

Table 6.1 shows that five factors have been identified by the EFA to affect port infrastructure tariff design. The first factor, '*port demand*', consists of four variables as identified by the EFA: the financial position of the port, costs to port users, service quality and trade flow. However, only service quality and trade flow have been confirmed by CFA to have influence on port infrastructure tariff design.

[23] Based on this section of the chapter and analysis results presented in the previous chapter, a paper entitled 'Port Infrastructure Pricing: Findings from a Survey of International Seaports' was presented at the annual International Association of Maritime Economists Conference 2014 held in Norfolk, USA.

Table 6.1: Factors determining port infrastructure tariff design.

Factors	Variables	EFA	CFA
Port Demand	D4 Port's financial position	✓	×
	D6 Total financial costs to port users	✓	×
	D5 Perceived service quality	✓	✓
	D7 Trade flow	✓	✓
Pricing Knowledge & Applicability	B1.1 Awareness of cost based pricing	✓	✓
	B1.2 Awareness of market based pricing	✓	✓
	B2.4 Awareness of discriminatory pricing	✓	×
	B2.1 Use of cost based pricing	✓	×
	B2.2 Use of market based pricing	✓	×
Industry Dynamics	D10 Tariffs of competing ports	✓	×
	C2 Competition with rivals	✓	×
	D9 Variability in ship size	✓	×
Pricing Objective	C3 Attracting cargo and port users	✓	✓
	C6 Regional economic development	✓	✓
	C4 Port capacity utilisation	✓	×
Cost Recovery	C1 Covering investment costs	✓	✓
	C5 Covering operation costs	✓	✓
	D1 Infrastructure investment cost	✓	×

✓ = significant × = not significant

Source: prepared by the author based on EFA and CFA results

The second factor, '*port pricing knowledge*' consists of five variables as identified by the EFA: knowledge of cost based pricing, market based pricing and discriminatory pricing methods, and the use of cost based and market based pricing methods. However, only the knowledge of the cost based and market based pricing methods have been confirmed by the CFA to have an influence on port infrastructure tariff design.

The third factor, *'industry dynamics'*, consists of three variables as identified by the EFA: the effects of the tariffs of competing ports, competition between ports, and ship size. However, all of these effects could not be confirmed by the CFA.

The fourth factor refers to the *objectives of port infrastructure pricing* and consists of three variables as identified by the EFA: attracting cargo and port users, promoting regional economic development, and improving port capacity utilisation. However, the CFA only confirms the effect of the first two variables.

The fifth factor, *'cost recovery'* consists of three variables as identified by the EFA: covering (total) investment costs, covering operational costs and the infrastructure capital cost. Since total investment cost includes infrastructure capital cost, only the first two variables have been confirmed by CFA. The following sections discuss the role and implications of these factors.

6.2.1 PORT DEMAND

The first factor influential to port infrastructure tariff design is the demand for port services. The result of the EFA and the CFA has confirmed the importance of trade flow in infrastructure tariff design. Trade flow is important because demand for port services is derived from trade (Seabrooke, Hui, Lam & Wong 2003; Suykens & Van De Voorde 1998) and therefore seaborne trade is considered to be a proxy for transport demand (Tinbergen 1959). Therefore, for given tariffs, the revenue from port charges for all port activities which include port infrastructure, port services for vessels, cargo handling and cargo storage, depends on the demand for the port services.

Jiang, Kronbak & Lopez (2013) found that a 1% increase in the cost of transport results in a 2.13% reduction in import volumes. Thus one way to promote trade would be to lower total transport costs. This can be achieved by having relevant polices in place. Furthermore trade flow needs to be considered in the design of the port infrastructure system and its improvements (Taneja, Ligteringen & Van Schuylenburg 2010). Thus trade flow is an important consideration when deciding the price of infrastructure services.

The results identify service quality as the second variable that is influential to port infrastructure tariff design. This reflects the fact that for a given port tariff, the decision by a user to use a port’s service depends on the quality of the services offered. In order to raise port demand, i.e. to attract more vessel traffic, an understanding of the sensitivity of port users to changes in the service quality and port charges is required (ADB 2000). This implies that the perceived service quality for port infrastructure and services is a port choice variable and can be considered as a port demand determinant. Given that port charges represent a relatively small portion of total shipping costs (Malchow & Kanafani 2004), the service quality offered by ports and the price they offer are very important to the port choice decisions made by carriers, shippers and freight forwarders (Chang, Lee & Tongzon 2008b; Lirn, Thanopoulou & Beresford 2003; Ng 2006; Slack 1985; Tongzon 2009). For instance, port sectors in South Africa indicated that port users were dissatisfied with the costs and service quality of South African ports (Trade and Industry Chamber 2007). According to Joy (1988) and Strandenes (2004), carriers with strong market power independently decide their ports of call and their decision is based on a number of factors such as service quality, port charges and regulation.

The perceived service quality by port users is vital for the purpose of improving economic and technical efficiency in those ports where the use of the existing port infrastructure is already at maximum capacity. Such efficiency improvements enhance both the actual and perceived service quality, which may help reduce costs for port users and shorten vessel time in port (Wang & Cullinane 2006).

In the presence of inter-port competition, setting appropriate port price and keeping up with higher service quality is a constraint to a port authority (OECD 2011). However ports with higher levels of services can benefit from higher port charges. As explained by De Borger & Van Dender (2006), in a duopoly environment there can be a large facility with higher levels of service quality at a higher price and a small facility with a smaller share of the market with lower service quality at a lower price. Competitive port markets are no exception; ports with higher levels of service quality are in a competitive position to charge relatively higher port charges compared to those with a lower level of service quality. Furthermore, among the challenges faced by port authorities in improving the long term competitive position of their port, understanding their customers' changing expectations regarding the quality and price of their services is a relatively important matter (Paixão Casaca 2008). The complementary nature of the use of port infrastructure and services implies that having a low perceived service quality in port services has an impact on port choice, and therefore on port infrastructure use. Thus the quality of port services needs to be considered in the tariff design for port infrastructure, mainly when setting the level of port charge.

The financial position of a port also needs to be considered when deciding port infrastructure charges. There is a link between a port’s financial condition and predatory pricing; a port in a healthy financial position can rely on this position to set lower port charges in order to force its competitors out of the market..

Total port costs to port users is one of the major determinants of port selection by carriers (Tongzon & Sawant 2007). The longer a ship stays in port, the higher the cost for its carrier will be. Since most port authorities calculate port dues and berth hire charges based on gross tonnage of the vessel and port stay time, the total port cost for larger vessels increases with the time spent in port. In the contemporary shipping industry cooperative agreements in the shipping industry, such as strategic alliances between major container lines, have resulted in increased pressure on port authorities to reduce the port costs incurred by vessels by lowering the port charges (Baird 1999). Thus, the consideration of the total port costs of different port users in the design of port infrastructure tariffs is a rather rational approach.

6.2.2 PRICING KNOWLEDGE & APPLICABILITY

The second factor influencing port infrastructure tariff design is the knowledge held by the port about port pricing and its applicability in tariff design. *Applicability* refers to the application and use of any existing knowledge about port pricing to tariff design. The knowledge and awareness of port authorities of different costs and pricing approaches are a prerequisite for developing cost based tariffs. Knowledge of port costs, and the short-term and long-term run costs of port infrastructure is needed for efficient port operation and investment decision making (Abbes 2007). The tariff determination process presented by Dowd and Fleming (1994) includes an internal examination of tariffs in which charges are calculated based on cost elements such as historic costs, imputed costs and a return on investment. This brings out a dichotomy in port pricing with regard to port authorities: one being the knowledge that port authorities have of various types of port costs and their consideration in port pricing, the other being returns on port investment for a given set of port tariffs.

From the perspective of total supply chain costs, the cost based pricing approach would improve the balance between overall costs and the benefits of port and supply chain activities (OECD 2009). The design of port tariffs should take into account the response of different port users to a new tariff level (ESCAP 2002). The results of the survey showed that 96% of the respondent ports agreed that they understood the cost based pricing approach while 90% of respondents stated that they implemented market based pricing techniques when designing port infrastructure tariffs.

One of the key objectives of cost-based tariff setting is to maximise the port infrastructure and service utilisation (Eriksson et al. 2009). However the cost-based tariff approach has its own weaknesses in that it provides less incentive for port authorities to reduce costs (Grosdidier De Matons 1986). Thus, the cost based pricing method, especially when used by government owned ports under no pressure for cost management, can lead to inefficiency in the provision of port infrastructure and facilities (Cullinane, Yim Yap & Lam 2006; Ircha 2001b; Song & Lee 2006; Vining & Boardman 2008). The public subsidy for port infrastructure provision and its continuation, as often found in the EU (Asteris & Collins 2009), is perhaps an example of the outcome of such inefficiency. In the U.S. port tariffs are held below the cost of providing the port's infrastructure and services in order to maximise the port's usage. This has led to a deficit which is financed through government subsidies (Winston 1999). Cost-based pricing would result in a complex tariff structure for ports that handle a wide range of cargos with a wide range of port facilities and that have many different users as a result (Gardner, Marlow & Pettit 2006).

The results indicated low levels of application of the social optimal pricing model when designing port infrastructure tariffs (only 21% agreed that it is applied) despite the relatively higher level of theoretical knowledge (46% of managers were aware of this) of port authorities on the same. This is perhaps due to, as confirmed by Núñez-Sánchez (2013) using Spanish port infrastructure fees, the presence of heterogeneity among port authorities in terms of the pricing objective, the different port demand conditions and elasticity, the different cost structures and port user characteristics. Thus, the 'public-good' nature of port infrastructure as described by Baird (2004) is not reflected in the pricing design of the port infrastructure tariffs of contemporary ports.

6.2.3 TARIFF OBJECTIVES

The objective of port authorities is important for tariff design. Port capacity utilisation, regional economic development and attracting cargo and port users are major objectives considered by ports when setting their charges. Where the main objective of a port is to foster sustainable development, tariffs are set to recover the costs incurred in the provision of port infrastructure and services, to promote the economically efficient utilisation of port infrastructure and to ensure a fair share of benefits for port users (Asian Institute of Transport Development 2001). Given the port user's willingness to pay, the provision of adequate capacity for incoming port traffic is vital for a carrier's port choice. Thus, increasing the utilisation rate of the port infrastructure is an important strategic driver for tariff design, which would generate higher revenues resulting in infrastructure cost recovery and a stronger competitive position for the port (Magala 2005).

Seaports are the major contributors to the development of port cities around the world. They contribute to the social, economic and environmental renown of the port location, and promote the regional and local economy (Brirsel & Cerit 2010). The economic development surrounding and associated with port cities can reach a situation of irreversibility even if the port is no longer relevant to the economic development (Fujita & Mori 1996). This follows the European doctrine that ports are a part of social infrastructure and their value can be assessed in terms of their contribution to regional development without much focus on raising profitability (Lee & Lee 2012). Thus the regional economic development objective has direct implications for port tariff design: if a high priority is placed on promoting regional economic development then revenue promotion will be hindered through the tariff design.

Interestingly only a few ports state their tariff objectives. For example, the Port of Melbourne Corporation clearly outlines its port pricing objectives which include: encouraging the efficient use of port facilities, promoting trade, and achieving cost recovery for all port activities including the provision of port channel and berthing facilities (Industry Commission 1993). Another tariff objective is to attract specific cargo and port users. Port managers plan and implement port marketing strategies in order to increase both port users and cargoes so that a higher level of profit can be achieved. Additionally, consideration is also given to different types of cargo and port users when designing port tariffs (Graillot 1986).

6.2.4 COST RECOVERY

The emphasis on cost recovery in port pricing is partly a result of the intention to ease the budgetary pressure of governments and allow ports to be financially independent from state subsidy (BTE 1989). This has led, as Notteboom (2008) noted, to most landlord port authorities operating as commercial undertakings aiming at full cost recovery. Port infrastructure development, particularly in developing countries, is often financed through international finance agencies. The funding agencies require that the tariff policies of ports are designed in such a way that investment costs are recouped (Grosdidier De Matons 1986). Furthermore designing tariffs based on the cost recovery approach is a key factor in promoting private sector interest and participation in port investment and operation (Kurek 2010).

Cost recovery is the main objective of port infrastructure pricing in many of the port authorities in the EU at recent times (Eriksson et al. 2009). Achieving cost recovery is influenced by political belief and can be a challenge for ports (Haralambides & Veenstra 2010). Failure to recover the costs of providing port infrastructure results in dependence on government subsidy and pressure on financial resources (Gardner, Marlow & Pettit 2006; Haralambides 2002). The challenge of financial pressure for new port investments can be overcome by strategic responses such as establishing a tariff policy regarding port dues and concession fees with a cost recovery basis (Verhoeven 2010a).

Current trends in concession agreements suggest that a greater consideration is being given to the cost recovery of port infrastructure investments (Rodrigue, Notteboom & Pallis 2010). More importantly the financial performances of East Asian port authorities demonstrate that port charges are set to achieve more than cost recovery and that the revenues from tariffs have fully compensated the increase in capital costs of port infrastructure construction (Abe & Wilson 2009). However establishing full cost recovery pricing for port infrastructure tends to change the market share of ports (Veldman & Buckmann 2003). In addition, there is also a suggestion that applying cost recovery pricing to port approach channels can hinder complementary transport modes, such as inland waterway traffic in some regions of the EU (Suykens & Van De Voorde 1998). Baird (1999) argued that even private ports in the UK and ports in Germany, the Netherlands, Belgium and Japan do not exercise full cost recovery pricing for port infrastructure, instead a free market rate for port use is exercised. Heaver (1995) suggested that policies designed for port cost recovery pricing need an international standard. A more extended approach of cost recovery can be the consideration of internalising the external costs of port operation.

Nevertheless, many ports have tried to achieve full cost recovery through their pricing policy. For instance the port tariffs of Victorian ports in Australia, especially the Port of Melbourne Corporation, have increased with the aim of recovering the cost of channel deepening projects (Essential Services Commission 2009) while ports in New South Wales (NSW) streamlined the *Port Management Act* with the objective of achieving full cost recovery (The State Government of New South Wales 1995).

6.2.5 PORT INDUSTRY DYNAMICS

The dynamics of the port sector refers to the competition and interaction between ports and port users. This variable has been identified by the EFA. With regard to competition, the demand for a service at a particular port can be sensitive to the price at that port as well as the price for the same service at any adjacent competitor ports. The sensitivity of demand is increased if ports share the same hinterland. Thus, ports with higher service quality and lower prices, attract higher demand (Shinohara 2012). The level of competing ports tariffs can be changed at the discretion of the competing port's port authority or it can be lowered due to total cost increase in the considered port due to port hinterland investment that induce traffic and high congestion (De Borger, Proost & Van Dender 2008). In such circumstances, port management needs to consider the port charges of adjacent ports when designing tariffs. Ports use the information characteristics of port users such as vessel size, type of vessel service, whether they engage in liner shipping or short sea shipping, and the frequency and type of vessel cargo, to establish differentiated port tariffs (Wilmsmeier 2007).

In addition, the adequacy and quality of port infrastructure such as berth and access channel depth are important variables for user port choice (Paixao Casaca, Carvalho & Oliveira 2010). Thus the maintenance of adequate high quality port infrastructure demands continuous monitoring of the depth of berths and access channels and requires the preparation of a dredging management plan to ensure that the requirements demanded by port users are met. As a response to changing global industry trends such as the increase in vessel size, ports have embarked on plans to modernise port infrastructure that include deepening access channels, turning basins and alongside, and lengthening berth facilities. This further benefits port users and has a positive impact on the total maritime transport costs (Wilmsmeier, Hoffmann & Sanchez 2006). Thus ports continue to invest in port infrastructure development in order to curtail competition effects from other adjacent ports and to capture a larger share of the shipping market (Anderson, Park, Chang, Yang, Lee & Luo 2008).

6.2.6 STRATEGIC IMPLICATIONS FOR POLICY MAKERS AND PORT MANAGEMENT

The findings of the EFA and CFA on the factors influential to port infrastructure design provide important implications for port management in terms of port tariff policy and port financial planning. First, when setting port infrastructure tariffs, port managers should carefully account for port demand and its variability over a time. In other words, port tariffs should be adjusted in response to changes in the demand for port services, especially in terms of the trade flow and service quality. Lowering port charges make port demand high and resulting higher trade flow means greater use of the port and utilisation of port infrastructure. While maintaining higher levels of service quality, total costs to the port users need to be reasonable without compromising financial benefits. Given the increasing level of competition in the port sector as a result of overlapping hinterlands or transhipment hub status, as well as the increasing concentration (reduction of players) in the liner market, port users especially shipping lines are now in a better position to choose their ports of call and service network. For that reason, port authorities need to formulate a monitoring mechanism of the pricing practices of adjacent ports upon which the tariff design and review decisions of their port can be based upon. In addition, such decisions on the level of port tariffs can be used as competitive tools against competing ports while maintaining the integrity of the tariff policy with respect to regional competitive laws or regulations. Further port infrastructure tariffs, mainly, port dues and berth occupancy charges, can be differentiated.

Knowledge of pricing theories would support the practical tariff formulation process. Port managers appear to have a considerable knowledge of cost based and market based pricing approaches but the survey results indicate that they have limited knowledge of the tariff design process. This is perhaps due to history and inertia, where tariff design practices have been originally established by port organisations and followed without any modification or, as stated by many scholars, this may be because of the lack of accurate costing data with regard to port infrastructure and maintenance. In this context, this study suggests that port management needs to look at the available knowledge base in the port organisation and make use of it in the tariff design process. In addition, port costing data on port infrastructure provision needs to be appropriately compiled for use in tariff design.

Further, port infrastructure tariffs mainly port dues and berth occupancy charges can be offered with some differentiation.

Setting the objective of port pricing is important as it informs the making of decisions on the tariff structure and level. For example, if the objective is to maximise profit or return on investments, tariffs tend to be higher than the socially optimal level and the port throughput tends to be lower than the socially optimal level (Brooks & Pallis 2008). On the other hand, tariffs need to be set at sufficiently low levels if the objective of pricing is to achieve higher port capacity utilisation, attract different types of cargo and port users, and promote regional economic development. One of the objectives may be to attract a certain type of cargo and or port user. For instance, in order to promote container trade, tariff design needs to take in to account liner vessels and their characteristics.

The analysis results are consistent with the findings of Tovar & Wall (2014), whereby the degree to which ports can modify tariffs depends on the demand variability implied by forecasted traffic level; and tariff objectives such as achieving annual profitability and return on investment (reasonable yields on assets). Demand variation should also be taken into account during tariff policy formulation.

Port organisations need to be able to self-finance their operation. The financial performance of a port in terms of revenue and expenditure statistics should form the key basis for the formulation of port tariffs (Frankel 1987). Taking into account the revenue and expenditure relating to port infrastructure is important for self-financing ports, to ensure that port charges at least cover the cost of infrastructure and facility maintenance. As such, many port authorities have attempted to formulate a port tariff strategy which attracts more port users while recovering the costs associated with port infrastructure investment, operation and maintenance (Park, Min & Sung 2015). Mainly in the context of the EU ports, policy directives are in place for the pricing of port infrastructure such that the 'public-good' nature of port infrastructure development (facilitating trade and regional development) has been replaced with the commercial objective of recouping the total cost of the infrastructure provision from the port users and direct beneficiaries of the ports (Bergantino 2002). Thus, a consideration of the cost recovery for the investment and operating costs of port infrastructure should be made when designing port tariffs.

Establishing cost based pricing has direct implications for national port policy. National port policies (mainly in the EU) are reorientating from the adoption of uniform cost based pricing principles towards incentives that promote cost based pricing (Haralambides 2002). Since port policies and administrative structures have not been developed historically from the perspective of ports as competitive businesses, establishing cost based tariffs will pave the way towards achieving financial viability and self-reliance for ports (Heaver 1995). Some port authorities have embarked on restructuring their administrative structures to be more corporatised and have changed pricing regimes to be more cost based. For instance, ports in South Africa have been amalgamated and are now managed as commercial business entities (public limited companies), while port dues and berth dues have been adjusted to be cost based (Chasomeris 2014). Similarly, all New Zealand ports and the major ports in the Australian states of Victoria, Queensland, South Australia and NSW have been corporatised and tariffs designed in relation to costs (Bandara & Nguyen 2014). Port management needs to have full autonomy to make their port tariff decisions (Gardner, Marlow & Pettit 2006).

Port managers may need to review their infrastructure tariff policy and ensure that revenues generated from offering port infrastructure to port users can sustain future port infrastructure provision, maintenance and capacity expansion. The quality of port infrastructure also needs to be taken into account when setting tariffs. As port users are prepared to pay for efficiency in port infrastructure and services (Wilmsmeier, Hoffmann & Sanchez 2006), ports are in a position to increase port charges in order to recoup the capital expenditure on port infrastructure. Nevertheless, designing an effective tariff structure for the use of port infrastructure is often a difficult task due to the fact that, owing to the high capital cost of construction, port infrastructure requires a long period of time for cost recovery. Thus port management needs to establish an effective strategic management plan for the port that enhances port performance and encourages the efficient use of port capital investment (Cheon 2007). This is pivotal for port tariff design, as ports that can provide efficient port infrastructure are competitive.

The findings from the analysis presented in this study also have implications for the involvement of government in the port sector, as reflected in the findings concerning the governance model and administrative structures. In the landlord port model, there is a substantial government intervention in port decision making, particularly if the port administration is operating under a statutory port authority. According to the survey results, the involvement of representatives from the government (port ministry) in the tariff review and the requirement of the ministry's and any regulatory body's approval for the port tariff, tend to limit the autonomy of the port authority and hinder the ability of port management to take a more market oriented approach to the management of port services. Thus, relevant government bodies need be aware of a port's financial requirements, especially in the prevalent climate of public budget constraints, and understand the need to reduce costs to port users, improve port service quality and raise the financial position. Thus overall the consideration of cost recovery in designing infrastructure tariffs not only eases the financial pressure on port authorities but also attracts funding for infrastructure development. Ports need to be able to self-finance their operations in the contemporary economic situations found in many developing countries.

6.3 PORT INFRASTRUCTURE PRICING PRACTICES

Port infrastructure pricing practices have been discussed in the port pricing literature. However factors influential to tariff setting practices have not been given much attention. This section discusses the main factors influential to infrastructure tariff setting practices, the tariff formulation procedure including its participants, the level of knowledge by port authorities of port pricing and the knowledge required by them for infrastructure tariff design.

6.3.1 FACTORS INFLUENTIAL TO PORT INFRASTRUCTURE PRICING PRACTICES

Table 6.2 summarises the factors and their associated variables, that influence port infrastructure tariff setting practices as derived from the results of the EFA and CFA presented in chapter 5.

The CFA results show that tariff setting practices are influenced by three factors: *tariff policy*, *transparency* and *stakeholder participation* in tariff setting. The factor of *tariff regulation* which contains the variables of regulatory control, government approval and adhering to publish tariffs, appears to have an insignificant influence.

Table 6.2: Factors influential to port infrastructure tariff setting practices.

Factors	Variables	EFA	CFA
Tariff policy	E3.5 Revising tariffs as per port's competitive position	✓	✓
	E2.1 Having a policy guideline for tariff design and revision	✓	✓
	E2.2 Having a policy on rebates and discounts	✓	✓
	E3.4 Revising tariffs as per port's strategic plan	✓	×
	E4.3 Obtaining inputs from commercial and planning department	✓	×
	E3.2 Adjusting tariffs with inflation and input cost	✓	×
Tariff Regulation	E2.4 Having a tariff regulatory control	✓	×
	E1.3 Needing government approval for revised tariffs	✓	×
	E2.8 Adhering to published tariffs	✓	×
Transparency	E2.5 Offering composite tariffs	✓	×
	E2.7 Offering negotiable tariffs	✓	✓
	E2.9 Offering a lump sum port fee	✓	✓
Stakeholder participation	E1.4 Obtaining feedback from port users	✓	✓
	E1.5 Obtaining feedback from port operators	✓	✓

✓ = significant × = not significant
Source: prepared by the author based on EFA and CFA results

6.3.1.1 TARIFF POLICY

As suggested by the EFA results (Table 6.2), the tariff policy factor is associated with six variables: revising tariffs as per the port's competitive position, having a policy guideline for tariff design and revision, having a policy on rebates and discounts, revising tariffs as per the port's strategic plan, obtaining inputs from the commercial and planning departments, and adjusting tariffs with inflation and input costs. These tariff practices are associated with various objectives. For example, one of the objectives is to generate an adequate return on investments made on port infrastructure, which has been long recognised as the main rationale for including a tariff policy in port investment proposals (Bennathan & Walters 1979). A port tariff policy is important for port efficiency and any changes in port tariff structures impact on port efficiency (Tongzon, 1995). UNCTAD (1996) provides directives in port planning for developing countries where a typical port authority can have a statutory power over the tariff policy through tariff regulation to safeguard the public interest. However this would be only possible when a national port authority manages all the ports (The World Bank 2007a).

Having a clear policy on rebates and discounts is an important element of tariff policy. From the legal viewpoint, rebates and discounts are considered to be price discriminatory practices (Geradin & Petit 2006). Offering rebates and discounts on various port charges for the use of port infrastructure and facilities such as berths is a form of strategic port pricing (UNCTAD 1996). Most ports implement their rebate and discount policy in various forms. For example, Romanian port companies publish port tariffs with rebates offered based on specific cargo and vessel types on a non-discriminatory basis for all port users (OECD 2011). Non-discriminatory tariffs and rebates will lead to the impartial treatment of all port users and may perhaps be effective in retaining port users. Offering rebates on port charges has also been included in national port policies and regulations in some countries. In the French port sector, there is a clear rebate policy for port charges on vessels: rebates on port charges for regular liner vessels are up to 50% of a base level port charge depending on the frequency of departure, while other types of vessel only receive up to 30% of the base level port charge (ISL 2006). An important aspect of rebates of port charges is that they are used as an element in port competition strategy. The National Port Policy for Malaysia demonstrates that restructuring the rebate and tariff policy for Malaysian ports is a vital strategy in the regional port competition (Mak & Tai 2001). Rebates can also be used to encourage a port user occupying a port infrastructure facility to follow efficient practices, and offering rebates based on user performance results in a performance based pricing (UNCTAD 1995b). However, offering rebates and discounts has its drawbacks as most port authorities around the world offer rebates on port dues, which result in arbitrary tariff structures (Notteboom & Winkelmans 2001). Hence, port authorities should be cautious about such tariff practices.

A tariff policy is a useful tool to attract the private sector into port investment, especially when there is high inter-port competition. ADB (2000) indicated that port traffic and tariff policy along with other variables such as risk allocation and financial requirement are required in order to attract private sector participation in port projects. Thus ports with clearly defined tariff policies can attract private sector investments. For instance in India, following private sector investments in ports, a tariff policy for newly developed port infrastructure has been developed (Yahya 2003).

6.3.1.2 TARIFF REGULATION

The second factor influential to port infrastructure practices concerns tariff regulation. Important practices related to tariff regulation include the presence of a regulatory control over tariff setting, government approval for revised tariffs and the publication of new tariffs. Tariff regulation is initiated as a result of a lack of competition between ports and governments imposed tariff regulation as a means of controlling monopoly behaviour (Kent & Ashar 2001). However, following the private sector participation in the port sector, especially in the provision of port infrastructure, the need for tariff regulation has arisen in order to ensure fair competition (Ray 2004).

One of the ways to regulate tariff setting is to establish a separate regulatory body to oversee the tariff regimes of ports (ADB 2000). Public ports and even private port operators, especially in a non-competitive port market, are reluctant to limit or lower their existing port charges, hence tariff regulation by an independent regulator is required for protection against any abuse of port power (The World Bank 2007c). For instance, in the Mexican port sector, the Mexican Anti-Trust Institution determines the tariff regulatory requirements and more importantly the port dues on infrastructure are subjected to price caps which are revised based on the level of competition (Estache, González & Trujillo 2002). Similarly, in the Australian port sector, two major state ports (Melbourne and Sydney) are subject to monitoring by an independent price regulator (Bandara & Nguyen 2014; Everett 2007; Menezes, Pracz & Tyers 2007).

6.3.1.3 TRANSPARENCY FACTOR

Transparency in port pricing is important as it provides the users with clear information on the charging basis and its composition (Asian Institute of Transport Development 2001). Transparency is a common factor that has been discussed regarding all the aspects of port operation including port accounting systems, financial flows, the port regulation mechanism and pricing practices, and receives greater attention with regard to port pricing policies. Nevertheless, the shipping charges of ocean carriers are characterised by a lack of transparency in their calculation methods (Oliveira 2010) and port tariffs imposed by ports on carriers are also viewed as not transparent (Meersman, Van De Voorde & Vanelslander 2002; Strandenes 2004). Thus, promoting transparency in port pricing has been mandated by the Standing Committee on Developing Services for Shipping in Ports (UNCTAD 1996). A transparent pricing structure is required for any common user facility (Wilmsmeier, Monios & Lambert 2010) and is in the interest of port users

(Meersman, Van De Voorde & Vanelslander 2002). It is argued that the decentralisation and increasing financial autonomy of the port sector have helped to create a lack of transparency in port pricing (Daniela 2013), although increasing financial autonomy will contribute towards achieving full cost recovery (Haralambides et al. 2001). Establishing transparency in port pricing is essential to ensure a level playing field within and between ports (European Commision 2007). Thus in their port reform processes some national governments have strived to make all port activities transparent. For instance, Italian port reforms proposed to enhance transparency in terminal concession agreements and determine concession fees on rate of return principles (Parola, Tei & Ferrari 2012).

One of the tariff practices related to transparency is the offering of negotiable port charges that may differ from published port tariffs. The lack of transparency for negotiated port charges is viewed as a barrier to the effectiveness of port tariff differentiation (Enei 2010). Further, the issue of the lack of transparency in port business, particularly in port pricing, results in under-priced port infrastructure and inaccurate demand forecasts which can lead to an overcapacity problem in ports (Terada 2002). The lack of transparency in the tariffs charged to shipping companies hinders the identification of true port costs, as well as the comparison of costs between ports, which is critical for shipping lines when selecting ports. The lack of transparency in port pricing is an obstacle to the effective planning and management of the logistic chain by shippers (Paixão and Marlow 2002). Improvement in the transparency of port operation is thus the key to promote healthy competition in the port sector.

6.3.1.4 STAKEHOLDER PARTICIPATION

Stakeholders of an organisation include all the individuals or groups who can be affected by the decisions of the managers of the organisation. These include employees, customers, communities and government representatives (Sternberg 1997). The stakeholders of a port can include shippers, carriers, adjacent ports, logistics companies and governments (national, local and regional). Stakeholder participation in pricing decisions can help to improve the transparency of port pricing and allow ports to obtain feedback on their prices and service quality. However, obtaining feedback from port users such as shipping lines and port operators about port tariffs can be a sensitive matter and their views are diverse. An example from the US port industry suggests that port user fees designed to cover dredging and harbour maintenance were supported by some stakeholder groups while opposed by others (Mcintosh & Skalberg 2010). This also provides a mechanism for relevant bodies such as user advisory boards or port user representatives to make informed and useful decisions (The World Bank 2007c). It is important that helpful stakeholder management practices related to port pricing are developed (Aert, Dooms & Haezendonk 2013). Developing and establishing a mechanism to liaise with port users, discuss and obtain feedback from port users and port operators on port costs and prices would improve the transparency of port charges (Industry Commission 1993). If ports can involve stakeholders in the tariff revision process, the level of transparency can be lifted and therefore port tariffs will not be subject to criticism.

6.3.1.5 POLICY AND STRATEGIC IMPLICATIONS

Port infrastructure tariff practices tend to vary substantially across ports (Wilmsmeier 2007). The findings presented in this study have revealed that such practices are influenced by four main factors: tariff policy, tariff regulation, transparency and stakeholder participation. The degree of influence these factors have on tariff practices differs among ports, so different approaches to tariff design practice, calculation and tariff levels exist. Thus the implications of these four factors to port management cannot be overlooked.

To stay competitive a port needs to adopt various strategies. Enhancing port performance and efficiency over rivals, while providing port services at reasonable cost is vital (Tongzon 1995). With the continuous building of mega-sized containerships, and thus hugely excessive capacity, the price charged to shippers by shipping lines are often relatively low. Thus port tariff design needs to consider this industry change and price port infrastructure to avoid market distortions. Nevertheless, as infrastructure cost is relatively small compared with the freight revenue gained by shipping lines, shipping lines, with the market power, pass the burden of port charge to shippers. It is the shippers that have to bear at least part of port charges.

Lowering port charges is important as far as total logistical costs to the user are concerned and port costs (port charge) are a significant determinant of the port selection by users (Chang, Lee, and Tongzon 2008; Tongzon and Sawant 2007). Therefore revising tariffs as per a port's competitive position allows a port authority to not only retain existing port users but to also attract new port customers.

Tariff practices related to port infrastructure can be used to achieve specific industry outcomes. Offering rebates and discounts is perhaps a popular tariff practice objective. For instance, examples of port marketing tactics that are used are to set a concessionary rate for feeder vessels calling the port, or to arrange priority berthing at a specific port facility. This attracts competitive feeder vessels to use the port and in turn the port is able to achieve regional or sub regional transhipment status (Frankel 1987). Further, considering logistical costs, the benefits of lowering port charges can flow along the total logistics chain to the final consumer of the goods.

Port tariff revision should not be done on an ad hoc basis if it is to be an effective tool to achieve corporate goals. Port management needs to establish clear policy guidelines for tariff revision with particular emphasis on the process and circumstances of tariff revision. Tariff revision requires detailed information of the financial position and performance of the port. It is intuitive that the performance data are usually maintained and possessed by the commercial and planning department (or equivalent) of the port management. Thus establishing a streamlined process for obtaining inputs from the commercial and planning department for tariff revision is a key task when conducting tariff revisions. Further, market based tariffs adjusted with inflation and input costs are necessary. This research shows that a port's commercial and planning department mainly contributes to the tariff design. In the process of tariff revision, the active involvement of the port's commercial and planning departments is important so that tariff setting can take into account the financial and operational performance and conditions of the port. In addition, the customer service or marketing department often deals with port customers and is the customer's first point of contact. Hence, this department should also be involved in the tariff setting and revision process.

Port authorities need to be cautious about offering rebates and discounts. The main objective of offering rebates on port tariffs is to retain existing port users and attract new port users. Nevertheless such a user-centric pricing practice for port infrastructure might not lead to the expected benefits to the port. If the port authority aims to recover the full cost of port infrastructure investment and management, the port has to assess the impact of rebates on port users and the resultant revenue flow into the port accounts. It follows that such customer-centric pricing strategies need to be assessed on the basis of service attributes, customer perceptions, and the circumstances of time and place by listening to customers' comments and feedback (Cross & Dixit 2005). Thus ports with highly commercially-oriented port infrastructure pricing objectives are required to design their tariff policy with directives for assessing the reaction of port users to rebates and the resulting impact on port revenues. This is primarily important as port users place different value propositions on port costs contributing to port selection decisions. The withdrawal of a shipping line from a port due to changes in tariff practice will have devastating effects not only on the port but also the entire logistics chain, because the commodity flow to and from the hinterland and foreland is disrupted. Thus a port authority has an unwritten obligation to preserve the logistical flow to and from the port hinterland it serves and maintains the interest and security of the all participants along the supply chain, such as shipping agencies, freight forwarders, transport providers, cargo owners and ultimately consumers.

One of the challenges facing public port authorities when setting port tariffs is that they only have limited discretion to set the tariffs. In addition, the prevalence of regulatory control over port charges also makes port tariff revision cumbersome. The requirement of approval of the regulator and the government for revised tariffs substantiates this with regard to port authorities that conform to a statutory port authority administrative model. However ports with a more autonomous administrative model, such as port corporations and limited companies, need to be aware of the subjectivity of the regulatory control over the revised tariffs. Thus tariff revision should be carried out to conform with the regulatory guidelines and requirements.

The transparency of port tariffs is often criticised by port users. While ports adhere to published tariffs it is important to communicate the basis of charging. The offer of composite and negotiated tariffs perhaps attracts and retains port users but is subject to criticism by the majority of port users. Offering a lump sum port fee payable in advance for the use of the port infrastructure for a particular time period is an effective pricing practice that guarantees a large sum payment, while the use of the port is only limited to a certain number of port users. This allows a port authority to better plan its future port operations and provide effective services for port users.

Having a policy guideline for tariff design and revision enables the port authority to exercise tariff setting and revision consistently. Such a policy can include an appropriate policy on rebates and discounts and allows the monitoring of the effect of tariff changes more effectively. Furthermore port authorities can include tariff revision directives in a port's strategic plan thereby making tariff revision a strategy overseen by port management on a continuous basis. The analysis results recommend that port management consider developing a port tariff policy in which the tariff implementation and revision process are clearly outlined. More importantly there is a regulatory control over port infrastructure tariffs while any revision of charges has to be approved by the government, perhaps from the regulator itself. As ports tend to obtain the participation of various stakeholders in tariff revision process, the level of transparency can be lifted. However there are still transparency issues with regard to offering port infrastructure tariffs as ports tend to favor offering negotiated tariffs, composite tariffs and lump sum payments possibly with discounted prices. These are perhaps ways of revenue management practices in ports or counter-veiling measures of inter-port competition.

6.3.2 PORT INFRASTRUCTURE DESIGN, REVISION AND APPROVAL PROCESS

The tariff policy factor was associated with the variables: having a policy guideline for tariff design and revision, revising tariffs as per the port's competitive position, revising tariffs as per the port's strategic plan, obtaining inputs from the commercial and planning section, having a policy on rebates and discounts and adjusting tariffs with inflation and input cost. The information provided by port managers to the open-ended question on port tariff formulation and the revision procedure revealed that most ports have formal internal body for the tariff formulation, revision and approval process. The process of port tariff revision and the approval process for different governance structures is shown in Table 6.3.

Whatever the administrative structure, port tariffs are agreed on by a port committee or a board of directors, usually the council of administration of the port authority. In municipal ports, the council comprises representatives of the public administrators and the port operators. The survey results indicate that about 60% of port authorities have a committee responsible for tariff formulation, review and revision, and that the technical aspect of port tariff formulation is the responsibility of a port's commercial section. Respondents revealed that the existing tariff structure is revised by a specific port department, often the Business & Operations Department, based on the market and certain other conditions and the revised tariffs are then approved by a committee of selected members chaired by the CEO.

Table 6.3: Port tariff revision and approval: participants and the process.

Port Administrative Model	Internal body	Reviewers	Government Rep	Approval Body	Feedback	Process
Municipal Port enterprise	Port committee/board	Commercial section	Council representative	-	-	Internal departmental review→ internal committee → implement
Statutory port authority	Board of directors	Internal staff/CEO/	Ministry representative	Ministry/ Regulatory approval	Port users	Internal review → Board of directors → ministry recommendation → regulatory approval → implement
Commercialised port authority	Board of directors	Port management	-	Ministry approval	Port users	Internal review → Ministry approval
Port department	Internal committee	Port financial section/CEO	-	Ministry approval		Internal review → Ministry approval → implement
Port corporation	Board of directors	Each port department	-	Ministry approval	Port users	Internal review → Board of directors → customers feedback → implement
Private limited company ports	Board of directors	Internal review/ external consultants/CEO	-	-	-	Consultant → CEO → Board of directors → implement

Source: compiled by author based on survey data

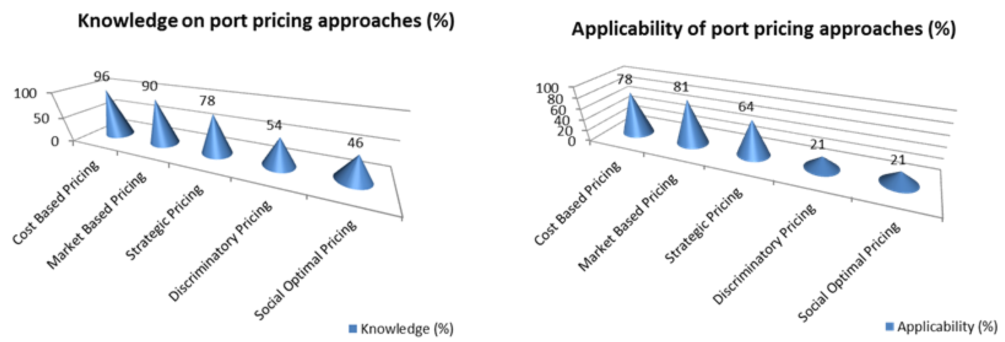
The results of the analysis confirm that the commercial department of the port plays a key role in tariff design. In addition, ideas are generated internally by the department that owns the tariff and then, after consultation with port users, any proposed fee changes are forwarded for internal approval of the Executive Committee or the Board, upon which a notice of the fee change is published before the fee comes into effect. In addition an internal port tariff committee works with port operators to review tariffs based on the Consumer Price Index (CPI) and usually reviews tariffs in the event of new port investments, identifies new port users and suggests incentives to offer to port users. This suggests that adjusting port tariffs according to input costs and inflation is a common tariff revision practice although tariff revision after new investment was not been found to be significant, with the agreement of only 3.5/9 respondents.

Overall, it can be concluded that in all port administrative structures a port committee or a board oversees the tariff design, revision and approval process. Various departments of the port contribute to the tariff revision process which includes an internal examination of the revised tariffs before forwarding to an external examination with port operators and users. Apart from private limited company ports, the tariffs of ports operating under the other port administrative models are subject to government and/or regulatory approval. Private limited company port authorities offer more market based tariffs. Adjusting tariffs to annual inflation is a major feature in the tariff revision process among them.

6.3.3 KNOWLEDGE OF PORT PRICING APPROACHES AND THE TRAINING REQUIREMENTS OF PORTS IN PORT INFRASTRUCTURE TARIFF DESIGN

Figure 6.1 (same as figure 5.9) summarises the responses of port managers concerning the knowledge and applicability of port pricing approaches. Many port pricing methods exist. 96% of ports are aware of cost based pricing approaches but only 78% agree that cost based pricing approaches are applied to their port tariff design. Respondents revealed that they require a more accurate approach to establish cost based prices. This is also discussed by Haralambides (2002) who found that establishing more accurate cost based tariffs requires proper and transparent accounting systems. Thus, ports need to share their knowledge, experience and best practice in this regard. Information and knowledge sharing can be facilitated by relevant international and national associations and bodies such as the Port Association and United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). It is also recommended that ports outsource their tariff setting tasks to external consultants or businesses that have sufficient specialised knowledge and expertise in the field. For example, conducting a market survey for port tariff revision purposes can be a tedious task for internal port departments where no suitable expertise is present.

Figure 6.1: The knowledge and applicability of port pricing approaches: The view of port managers.



Conducting a proper market survey of port's infrastructure of competitive ports is also a requirement for properly designing port tariffs. Thus port tariffs are market responsive and further promote competition and efficiency.

6.4 COMPARISON OF THE REGRESSION AND FACTOR ANALYSIS RESULTS

One of the advantages of mixed method research is it allows for the triangulation of the analysis results. Triangulating research findings allows researchers to examine the subject from multiple perspectives leading to a better understanding of results with newer and deeper dimensions (Jick 1979). The analyses presented in chapters 3 and 4 are based on two different methodologies, namely regression estimation and factor analysis. The former was based on secondary data for port infrastructure tariffs, proxies for port infrastructure costs, port demand and dummy variables for the port administrative and governance models. The latter was based on primary data collected from a survey of port mangers responsible for setting the port tariffs of major ports worldwide. Table 6.4 summarises the results of the regression estimation and the factor analysis with regard to the determinants of infrastructure tariffs.

Table 6.4: Comparative results of the regression estimation and the factor analysis of the determinants of port infrastructure tariffs.

Regression Estimation		Factor Analysis			
Variables		Factors	Variables	EFA	CFA
Trade flow*	→	Port Demand	Port's financial position	✓	×
			Total financial costs to port users	✓	×
			Perceived service quality	✓	✓
			Trade flow	✓	✓
-		Pricing Knowledge & Applicability	Awareness of cost based pricing	✓	✓
			Use of market based pricing	✓	×
			Use of cost based pricing	✓	×
			Awareness of discriminatory pricing	✓	×
			Awareness of market based pricing	✓	✓
-		Industry Dynamics	Competing ports' tariffs	✓	×
			Competition with rivals	✓	×
			Variability in ship size	✓	×
-		Tariff Objective	Port capacity utilisation	✓	x
			Regional economic development	✓	✓
			Attracting cargo and port users	✓	✓
Channel length*	→	Cost Recovery	Covering investment costs	✓	✓
			Covering operation costs	✓	✓
Channel depth*			Infrastructure investment cost	✓	×
Port administrative model**		-	-	×	×
Port governance model**		-	-	×	×
Port location**		-	-	×	×

* = Significant with channel dues. ✓ = Significant × = Not Significant

** = Significant with both channel dues and berth occupancy charge.

\- = There is no corresponding variable.

As shown in Table 6.4, the role of trade flow in the determination of port infrastructure tariffs is significant and has been confirmed by both analyses. The regression estimation results showed that an increase in total trade value of 1% is associated with a decrease in channel due of 0.11% on average, while trade flow is a higher loading variable in the latent factor *port demand*.

Similarly cost recovery has a significant role in tariff determination. The regression analysis results indicate a significant relationship between channel dues and port costs (proxied by channel length and depth): an increase in channel length of 1% would increase the channel/port due by 0.26% and for channel depth, a 1% increase in channel depth would decrease channel due by 0.53%. The results suggest that longer channels require higher maintenance costs, thus higher channel dues are applied, while deeper channels require less dredging and lower channel dues are applied. The results indicate the requirement of cost recovery for channel maintenance. Similarly, the *cost recovery factor* derived from the factor analysis is associated with variables such as covering the investment and operational costs of port infrastructure, which again confirm the former proposition of cost recovery. Thus the two methodologies have produced similar results with regard to both port demand and cost recovery.

The dummy variables in the regression estimation (the port administrative model, port governance model and port location) have a significant impact on the level of port infrastructure charges. Unfortunately these variables were not considered in the factor analysis, although they were included in the survey stage, due to limited responses for each administrative and governance model. In addition, the fact that most ports conform to the landlord model also limits such analysis. On the contrary, the variables pertinent to factors on pricing knowledge and applicability, industry dynamics and tariff objectives were not included in the regression estimation due to their type of measurement (nominal). However the EFA and CFA suggested that they are significant factors affecting port infrastructure design. Thus, from the viewpoint of the research methodology, the comparative analysis suggests that complementing the pure quantitative method with a qualitative data analysis technique allowed the triangulation of research findings. In addition, the employment of two analysis methods to study the same problem allows the study of those variables that cannot be included in one of the methods.

6.5 RESEARCH QUESTIONS AND HYPOTHESES

The results of the EFA and CFA presented in chapter 5 and further discussed in this chapter above provide answers to the research questions and hypotheses proposed in chapter 4.

6.5.1 RESEARCH QUESTION I: WHAT IS THE LEVEL OF APPLICABILITY OF PRICING APPROACHES IN THE DEVELOPMENT OF THE PORT INFRASTRUCTURE PRICING MODELS?

Four research hypotheses were proposed for Research Question I:

RH1: Seaport authorities possess substantial knowledge on port pricing theory and principles.

RH2: Seaport authorities to a larger extent apply port pricing principles in port infrastructure pricing.

RH3: Seaport authorities often attempt to formulate efficient cost based port infrastructure tariff design.

RH4: The majority of seaport authorities follow a structured procedure for the port infrastructure pricing process.

The results indicated that the majority (80%) of the port managers surveyed are aware of cost based and market based pricing and agreed that they are applied in tariff design. The result of the EFA showed that port managers are aware of cost based pricing, market based pricing and discriminatory pricing approaches, but only market based pricing and cost based pricing approaches are used in their tariff design. However the results of the CFA showed that port mangers are only aware of cost based and market based pricing and that these have limited application in practice. These results support and suggest that both *RH1* and *RH2* are partially supported as s*eaport authorities only have knowledge on the cost based, market based and discriminatory pricing approaches*. In addition, although there is no strong evidence to support *RH2* that seaport authorities apply port pricing principles in port infrastructure pricing, the EFA results have indicated that *seaport authorities to a larger extent apply cost and market based pricing principles in port infrastructure pricing*.

Regarding *RH3* (the third research hypothesis), both the EFA and CFA results suggest that port infrastructure tariff design is influenced by the cost recovery consideration of the port management and this includes covering port investment costs and port operation costs. *RH3* is fully supported by the results of the analysis. It can be concluded that ports often try to formulate cost based infrastructure tariff design.

Regarding *RH4* (the fourth research hypothesis), both the EFA and CFA results for port infrastructure practices generated a latent factor *stakeholder participation* which is associated with practices such as obtaining feedback from port operators and port users on infrastructure tariffs. In addition, the information gathered on the tariff formulation procedures of ports indicated the processes of port tariff revision and the approval protocols that are followed by ports with different administrative structures, and a little divergence was noted in the parties involved internally and externally to the port with respect to the port administrative model. Nevertheless there is enough evidence to support *RH4* (that port authorities follow a structured procedure for the infrastructure pricing process). Thus another significant finding of this study is that ports tend to follow a set procedure in the design and revision of their infrastructure tariffs. This is confirmed by the existing literature, such as Dowd and Flemming (1994), Talley (1994) and Psaraftis (2005) on the port pricing process.

6.5.2 RESEARCH QUESTION II: WHAT ARE THE FACTORS INFLUENTIAL IN DETERMINING PORT INFRASTRUCTURE TARIFF DESIGN?

One research hypothesis was proposed for Research Question II:

RH5: Port infrastructure tariff design is influenced by the port's organisational objective, costs, financial position, demand related aspects, competition and government policy and regulation.

The EFA has identified five factors influential in tariff design: (a) port demand, (b) pricing knowledge and applicability, (c) industry dynamics, (d) tariff objective and (e) cost recovery as determinants of port infrastructure design. Each factor is associated with a set of variables including port objectives, port costs, the port's financial position (which also demonstrates the level of port demand), port user aspect and port competition, that affect port infrastructure design. The CFA results confirmed that (a) port demand, (b) pricing knowledge and applicability, (c) tariff objective and (d) cost recovery are major factors influencing infrastructure tariff design. However port industry dynamics such as port user aspects (vessel size variability) and port competition are not influential. Thus, it can be concluded that port infrastructure tariff design is influenced by the port objectives, port pricing knowledge of ports and the application of that knowledge to tariff design, port costs and port demand.

6.5.3 RESEARCH QUESTION III: WHAT ARE THE FACTORS AFFECTING PORT INFRASTRUCTURE TARIFF PRACTICE?

Two research hypotheses were proposed for Research Question III:

RH6: Port infrastructure tariff practices are influenced by port stakeholders, the level of transparency, port autonomy, regulatory regime, port user behaviour and the competitive environment that the port operates in.

RH7: The differences in the ownership structure and the administrative structure have significant influence on port infrastructure tariff practices.

The EFA results suggest four factors that influence infrastructure tariff practices: (a) tariff policy, (b) tariff regulation, (c) transparency, and (d) stakeholder participation in tariff setting. However the ‘tariff regulation’ factor could not be confirmed by the CFA. Tariff policy which includes the revision of tariffs as per the port’s competitive position, having a policy guideline for tariff design and revision, and having a policy on rebates and discounts, suggests that ports have a specific policy that guides their infrastructure tariff setting, and by which the port manages some autonomy over the tariff setting. The fact that the tariff regulation factor could not be confirmed by the CFA implies that there is little intervention from governments and regulatory authorities over port infrastructure tariffs setting. The other factors (stakeholder participation and transparency) include rather influential infrastructure tariff setting practices, such as offering negotiable tariffs, lump sum port fees and obtaining feedback from port users and operators.

The survey results could not test the last research hypothesis, *RH7*, as the small size of the sample was a constraint in analysing the data with respect to different administrative and governance structures. However the regression analysis of port infrastructure tariff determinants suggested that the port administrative structure and the governance structure have a significant impact on the level of port tariff.

6.6 CONCLUSION

The results of the EFA presented in chapter 5 based on the data collected from an international survey of 67 seaports representing the North and South American, European, East and South East Asian and Australasian regions, indicate that the factors affecting port infrastructure design are port demand, port pricing knowledge and applicability, port and shipping industry dynamics such as competition and vessel size, the tariff objective of the port and the consideration for cost recovery. The results of the CFA on the same data reject the port and shipping industry dynamics factors, but confirm the remaining factors. The analyses also found that the underlying factors influencing port infrastructure tariff practices are the existence of a port infrastructure tariff policy, tariff regulation, the participation of various stakeholders in tariff revision and the level of transparency.

The comparison of the results of the regression analysis presented in chapter 3 with the factor analysis in chapters 5 and 6 indicates that the factors of port demand and cost recovery have a significant influence on port infrastructure tariff design. Interestingly, the influence of variables such as the port administrative structure on the determination of port infrastructure tariffs have been captured by the regression analysis while factors such as the existing port authority knowledge and its application to current tariff structures, the port tariff objective, and the influence of port industry dynamics such as competition and port user characteristics on infrastructure tariff design were only captured by the factor analysis. The two analysis methods (the regression and factor analysis) appear to complement each other and help to triangulate the research findings.

Seven research hypotheses have been tested and the following six conclusions can be made based on the results of the data analysis:

- Seaport authorities have knowledge of cost based, market based and discriminatory pricing approaches and to a larger extent, apply cost and market based pricing principles in port infrastructure pricing.
- Cost based and market based pricing appear to be the most widely known infrastructure pricing methods.
- Port infrastructure tariff designs are influenced by port demand, the pricing knowledge of port management and its applicability, industry dynamics, the tariff objective, cost recovery, the governance model and administrative structure and the location of the port.
- Port infrastructure tariff setting practices are influenced by port stakeholders, the level of transparency, tariff policy, port autonomy, government policy and regulation.
- The majority of seaport authorities follow a structured procedure for the port infrastructure pricing process.
- The differences between the ownership structure and the administrative structure have a significant influence on port infrastructure tariff practices.

CHAPTER 7 : CONCLUSION

7.1 CONCLUSION

This study focuses on the factors that influence seaport infrastructure pricing. Firstly, an extensive review of the port pricing literature with a particular focus on studies of infrastructure pricing was conducted. The literature review found that infrastructure pricing has long been a topic for port research with an array of different issues such as the relevance and applicability of pricing principles, tariff structures, transparency, tariff differentiation and the tariff setting process being investigated. Nevertheless limited attention has been given to research on the factors that influence the tariff process and practices. Thus this study mainly focuses on deriving the determinants of two main port infrastructure charges: port channel dues and berth occupancy charges.

Secondly, the study carried out an econometric analysis of port infrastructure tariffs using cross sectional data for two types of infrastructure tariffs: channel dues and berth occupancy charges. The analysis used a sample of 159 ports. The independent variables were port infrastructure costs, trade flow, the port governance and administrative models and the geographical location of the port. The results of the simultaneous equation regression analysis indicate a two-way relationship between channel dues and berth occupancy charges. In addition, channel due is positively related to channel length, while channel depth appears to be negatively correlated to channel due. Thus net effect of these two characteristics of channel length and depth affect its price setting. Port demand measured by trade flow has a negative effect on channel due, but a positive effect on berth occupancy charges. Based on the analysis results, conclusions have been made with regard to the cost relatedness of port infrastructure tariffs:

1. The coefficient for the channel depth is significant and its negative value implies that the deeper the channel, the lower the channel due. This suggests that channel maintenance costs are generally lower for deeper channels that require less dredging, and as a result port authorities set lower tariffs for port dues and channel dues.
2. The coefficient for berth length is significant and its negative value implies that, the longer the berth the lower the berth charges per unit. Given that the port is fully utilised always, ports with many berths and longer berths can

accommodate more ships than ports with fewer and shorter berths and can therefore handle more cargo and achieve economies of scale.

3. Channel dues charged by ports operating under the port authority and port corporation administrative and legal structures are lower than those under the local government entity legal and administrative structure.
4. Landlord ports and service ports tend to charge less than private ports, implying that the former are supposed to play a dual role, while the latter are more profit-driven.
5. The infrastructure charges of Australian and North-West European ports are among the highest in the world.

Determinants of port infrastructure charges provide policy directives for port management in terms of designing port tariffs. In that port costs, port demand, port administrative and governance model, and port region affects the level of port infrastructure charge and port management can take decisions on the level of charge that they need to impose.

Thirdly, to gain more insight into the seaport infrastructure tariff design process and setting practices, the study conducted a survey of international seaports. The survey data from 67 ports in Europe, North America, South and Central America, Australia, South Asia and East Asia were analysed using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The results of the analyses showed that port demand, the pricing knowledge of the port authority, port competition, the tariff objective of the port and the cost recovery consideration of the port are the key factors that influence infrastructure tariff design; while tariff policy, tariff regulation, stakeholders' participation and the level of transparency influence port infrastructure tariff setting practices. In addition, tariff regulation has a limited influence over port tariff setting practices. Some of these results of the study are also consistent with the normative conclusion arrived by Meersman, Strandenes & Van De Voorde (2014) that the lack of transparency, the behaviour of various actors participating in setting port tariffs related to a port call, the lack of consideration in port pricing tools are featured in contemporary pricing structures of seaports. Influential factors on infrastructure tariff design and practices provide directives for port management to be aware and take necessary precautions to mitigate the issues in port infrastructure tariffs implementation.

Several implications for port management in terms of port tariff policy (tariff design and revision) and port financial planning can be drawn from these findings:

1. Infrastructure tariffs should at least aim to help to recover the cost of providing port infrastructure services and should contribute to future infrastructure development. This allows the port to be financially independent from the government budget.
2. Port management needs to adjust tariffs in response to changes in demand for port services, especially in terms of the changes in trade flow and the service quality. However in this case accurate forecast of changes in demand is a pre-condition for pricing setting.
3. When determining port infrastructure tariffs it is important to use the port's extensive internal information such as financial conditions, capital and operational costs, corporate objectives and the governance model. For this purpose, accurate compilation of port financial information, expenditure on capital and operational costs, setting up corporate goals aligned with the port governance framework are necessary requirements.
4. Tariffs can be used as effective tools to promote port demand and help improve the capacity utilisation rate. Different infrastructure tariffs and pricing strategies can be applied to different types of cargo and vessel traffic. For this purpose port authorities need to monitor and record cargo and port tariff mix and its trends and be able to provide sufficient capacity when and where necessary.
5. Seaports need to revise tariffs as per their competitive position and use tariffs as one tool alongside other marketing tools to maintain the loyalty of existing port users, and to attract new users. This will only possible if port authority can assess its competitive position and monitor its rival ports actions and reaction on achieving better market position within the port area. Thus port authorities need to device a mechanism to carry out continuous dialogue with port users for using the port.
6. Ports need to establish clear policy guidelines for tariff design and revision and enhance transparency in their tariff setting practices. This can be achieved by publishing ports tariff documents annually with time to time notification of tariff revisions along with underlying reasons. Further before

the revision takes place getting the relevant stakeholders in to a dialogue on intended tariff revisions enhances the transparency of tariff setting.

In line with the findings above and the results of the examination of the research hypotheses proposed by the study, the following conclusions can be made:

1. Port authorities are aware of cost based, market based and discriminatory pricing approaches and to a larger extent only apply cost and market based pricing principles to port infrastructure pricing.
2. Cost based pricing is widely used in port infrastructure tariff design.
3. Port infrastructure tariff design is influenced by the port's corporate objectives, costs, financial conditions, port demand, the users' perception of service quality and competition.
4. Port infrastructure tariff setting practices are influenced by tariff policies, tariff regulation, stakeholders' participation and the level of transparency.
5. The majority of seaport authorities follow a structured port infrastructure pricing process.
6. Different ownership and administrative structures have a significant influence on port infrastructure tariff practices.

7.2 LIMITATIONS OF THE RESEARCH AND IMPLICATIONS FOR FUTURE RESEARCH

This research is subject to limitations. These limitations mainly concern the research design and an unavoidable systematic bias (Price & Murnan 2004). This study used two main analytical methods: regression analysis and factor analysis. The regression analysis used port infrastructure dimensions as proxies for infrastructure costs because of the unavailability of relevant data. These proxies cannot fully exhibit the behaviour of port infrastructure costs. For example, future research may make use of data on dredging costs to help reduce the complexities related to the difference between the natural depth and the artificial depth of a port's entrance channels. The study only considered channel due and berth occupancy charge, which may not represent the behaviour of other types of charges such as terminal charges. Thus, future studies can extend the empirical framework and include additional charges, particularly terminal charges to cargo owners/shippers and charges for other services such as pilotage and towage. In addition, future research can also incorporate the role of port competition, the vertical relationship between variables in the supply chain and port-regional development.

There are also limitations pertaining to the factor analysis using the survey data. The survey participants are mainly from EU, North American and Australian ports. They represent the top level management of these ports and most of them have sufficient experience in tariff affairs. There are no questions on the validity of the responses to the survey questions. When compared with ports in developing countries these ports (the majority of those in the survey) are well organised in terms of management, financial planning and port operation, so the findings of the research may be more relevant to ports in developed countries. Thus future research needs to take into account the differences between ports in developed and developing countries.

Due to the limited responses from ports representing various port governance models and administrative structures, the effect of the port administrative model on the dependent variables through its influence on the tariff setting objective, cost recovery consideration, port competition and tariff setting practices as found in the study may not be representative. To overcome this limitation, future research needs to extend the sample size and have a higher survey response rate in order to capture the effect of variables impacting on tariff design and practices that can be attributed to different governance and administrative models. In addition, future research can extend the survey to include other geographical regions and to obtain more responses to the questionnaire. The inclusion of more responses from the Latin American, Middle Eastern, African and East Asian regions would help obtain more general and widely applicable results.

Further, some of the conclusions drawn from the literature review were not adequately addressed and one of these is the use of marginal cost pricing in port infrastructure pricing. There was no evidence of the use of marginal cost pricing in selected seaports. In addition empirical evidence for setting up an optimal port tariff was not found although the literature on port pricing has much emphasis on its principle from theoretical and policy perspectives. In addition, the differences between port governance models, competition, port user characteristics such as frequency of use, cargo volume and social and economic characteristics of seaports need to be considered in future research.

The methodological framework of the research is mainly designed to identify factors influential to infrastructure tariff design and practice and has not assessed the intensity of influence. Thus future research on the subject can focus on testing for which factors are more influential in determining port charges.

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APPENDIXES

APPENDIX I: THE QUESTIONNAIRE

PORT INFRASTRUCTURE PRICING:
A SURVEY OF INTERNATIONAL SEAPORTS

This survey is part of doctoral research on seaport infrastructure pricing. The survey aims to collect information on how port infrastructure tariffs are currently set by international seaports. Information collected from the survey will be analyzed in order to gain a better understanding of the determinants of seaport infrastructure pricing models and to draw implications for port management and policy makers. The questionnaire can be completed in less than 15 minutes and all information provided will remain anonymous and be treated as strictly confidential. Your participation is valuable to our research and is highly appreciated.

A. Seaport's Profile

This section includes information on the port's country; ownership, governance and administrative structure, and port's competition level (*Please select the option most relevant to your port*)

A1. The ownership:

☐ Public ownership-Central government
☐Public-State/Provincial government
☐ Public ownership-Municipal government
☐Public ownership-Local government
☐ Public-Private/Foreign partnership
☐ Private/Foreign company
☐ Private/Domestic company
☐ Other (Please specify) Click here to enter text.

A2. Governance model:

☐ Service Port ☐ Tool port ☐ Landlord port ☐ Privatised port
☐ Other (Please specify) Click here to enter text.

A3. Administrative structure:☐ Statutory public port authority ☐ Commercialised port authority

☐ Government department ☐ Statutory Corporation
☐ Government-owned limited Corporation
☐ Public limited company ☐ Private limited company
☐ Public trust ☐ Other (Please specify) :

A4. Please rate the level competition with other ports faced by your port.

	Not at all competitive ⟷								Highly competitive
Level of inter-port competition	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

A5. The country of the port: (Please state here) Click here to enter text.

B. Infrastructure Pricing Knowledge

This section includes information on your awareness of port pricing approaches, the pricing approaches currently adopted by your port.

B1. Please rate how well you are aware of the following pricing approaches.

	Not at all aware ⟷ Fully aware								
B1.1. Cost-based pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B1.2. Market-based pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B1.3. Social optimal pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B1.4. Discriminatory pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B1.5. Strategic pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

B2. Please rate the level of applicability of the above pricing approaches to **your port's current infrastructure tariffs**.

	Not at all applicable ⟷ Highly applicable								
B2.1. Cost-based pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B2.2. Market-based pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B2.3. Social optimal pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B2.4. Discriminatory pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
B2.5. Strategic pricing	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

C. Port Infrastructure Pricing Objectives

This section requests information on the port infrastructure tariff objectives of your ports. Please rate the level of agreement on the following objectives of **your port's i**nfrastructure tariff design.

	Not at all agree ⟷ Strongly Agree								
C1. Recover the investment costs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C2. Compete with rival ports	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C3. Attract specific types of cargo or port users	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C4. Increase port capacity utilisation	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C5. Cover the operational costs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C6. Promote regional economic development	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C7. Achieve higher return on investment	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
C8. Other (please mention)	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

D. Factors Influencing Port Infrastructure Tariff Design

This section includes possible factors your port might consider in designing port infrastructure tariffs. Please rate the level of importance of each of the following factors to infrastructure tariff design for **your port**.

	Not at all important ⟷ Highly important								
D1. Infrastructure investment costs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D2. Infrastructure maintenance costs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D3. Rate of inflation	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D4. Port's financial position	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D5. Perceived service quality of users	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D6. Total port financial cost to users	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D7. Trade flow	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D8. Number of ship calls	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D9. Variability in vessel size	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D10. Level of competing ports' tariffs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
D11.Government policies & regulation	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

E. Infrastructure Pricing Practice: Parties Involved, Transparency and Revision of Tariffs

This section is about the parties involved, transparency in the formulation, review and revision of port infrastructure tariffs.

E1. Please rate your view on each of the following with regards to **the parties** involved in infrastructure tariffs of **your port**.

	Not at all agree ⟷ Strongly agree								
E1.1. My port has a committee responsible for tariffs formulation, review and revision	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E1.2. Different departments in my port are involved in the tariff design or revision process	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E1.3. My port is required to seek approval from the	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

government/responsible body for tariff revision									
E1.4. My port usually gets feedback from port users on revised tariffs before implementation	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E1.5. My port gets feedback from the port terminal operators on proposed tariff changes before implementation	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

E2. Please rate your view on each of the following with regard to **the transparency** of infrastructure tariff setting of **your port**.

	Not at all agree ⟷ Strongly Agree								
E2.1. My port has a specific policy guideline for designing and revising port infrastructure tariffs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.2. My port has a clear policy on rebates and discounts for port infrastructure tariffs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.3. My port's tariffs are available to the public	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.4. My port's tariffs are subjected to a public regulatory authority	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.5. My port offers port users a composite port infra-structure tariff i.e. a bundle price	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.6. My port's tariff formulation and its revision process are made publicly available	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.7. My port offers negotiable port infrastructure tariffs for vessels under certain conditions	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.8. My port is mostly adhere to published port infrastructure tariffs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E2.9. My port offers port users a lump sum port fee payable in advance for the use of the port	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

E3. Please rate your view on each of the following factors in **infrastructure tariff revision of your port**.

	Not at all agree ⟷ Strongly Agree								
E3.1. My port revises infrastructure tariffs after every new investment in port infrastructure	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E3.2. My port adjusts infrastructure tariffs annually in accordance with the inflation rate and/or changes in input costs	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E3.3. My port revises infrastructure	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

tariffs in accordance with the change in port's demand level									
E3.4. My port revises infrastructure tariffs as per the port's strategic plan	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E3.5. My port revises infrastructure tariffs depending on the port's competitive position	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E3.6. My port revises infrastructure tariffs according to the financial position of the port	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

E4. Please rate the level of contribution of the following departments of your ports to infrastructure tariff revision.

	No contribution at all ⟷ Substantial contribution								
E4.1. Navigation &	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.2. Port Operation	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.3. Commercial &	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.4. Accounting & Finance	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.5. Human Resource	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.6. Marketing &	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.7. Port Engineering &	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9
E4.8. Other Click here to	☐1	☐2	☐3	☐4	☐5	☐6	☐7	☐8	☐9

E5. **About your port's** infrastructure tariff formulation, revision, approval procedure and expectations:

E5.1. How frequently does your port revise its infrastructure tariffs?

☐ Every six months ☐ Annually ☐ Every two years ☐ Very rarely
☐ No specific time line but according to market changes
☐ Port authority sets a specific timeline for tariff revision
☐ Other (Please specify) Click here to enter text.

E5.2. Please briefly describe your port's *tariff formulation, revision and approval procedure*.

Click here to enter text.

E5.3. Please briefly mention what kind of *training, support and assistance* your port needs in infrastructure tariffs design.

Click here to enter text.

F. Respondent's Profile

This section is about your position, attached department in the port and experience in port tariff related work. Please kindly provide the following.

F1. Your position:

☐ Chief Executive Officer ☐ Managing Director
☐ Port Executive-Department Head ☐ Port Executive ☐Other (Please specify)

Click here to enter text.

F2. Your administrative division/department:

☐ General Administration
☐ Engineering and Maintenance
☐ Navigation & Signalling Service
☐ Marketing and Publication
☐ Commercial/Planning
☐ Port Operations
☐ Accounting and Finance
☐ Other (Please specify)

F3. Years of experience in your current position:

☐ Less than 1 years ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years & above

F4. Years of experience in work related to port tariffs:

☐ Less than 1 years ☐ 1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years & above

Thank you. We highly value your contribution and time spent on this survey.

APPENDIX II: EXTRACT FROM OPEN ENDED QUESTIONS E5.2 and E5.3.

The survey is included with two open ended questions. First is pertinent to tariff formulation, revision and approval process of the respondent's port and second is on the training requirement for port managers with regard to port tariff designing.

RESPONSES TO E5.2

This section presents and review the responses given by port mangers on the above two aspects. The results are presented under different port administrative structures.

The responses received from port managers of s*tatutory public port authorities* with regard to port tariff design, revision and approval are presented below. Since the survey was conducted anonymously, the respondents' port authorities were not identified.

- *'Existing tariff structure is used for revision (items, rates) proposed by the Business & Operations Department based on the market and certain other conditions for consideration and approval by a committee of selected members (not permanent) chaired by the CEO normally annually but sometime on a as needed basis'.*
- *'Ideas are generated internally by the department that owns the tariff, then consultation with users takes place, then the proposed fee/change is revised for internal approval, by the Executive Committee or the Board, then notice of the fee/change is published, then the fee comes into effect'.*
- *'Internal committee works with Port operator to review tariff based on CPI review, new investments, identification of new users, incentives to offer'.*
- *'The port tariffs are agreed by the Port Committee that is the council of administration of the Port Authority. The council is made of representatives of the public administrations and of the port operators'.*
- *'Senior staff is responsible to review tariffs annually with the CEO and the CEO presents to the Board of Directors for approval'.*

- *'Tariff are revised annually with government recommendations based annually inflation rate; Annual Executive Board proposal and inside Port Community discussion; Submission to Regulatory approval'.*
- *'The basis of the tariffs is approved by the government. Every port has a little action range, about +/- 30%, to apply to the government established tariffs, depending to the strategy and the financial situation of the port'.*
- *'Tariff revision and approval is based on 5 year and strategic plans and objectives, Review by bi-state board representing the state governors.*
- *'We put to our attention: trends in European tariffs and in competing ports' tariffs/prices, new solutions and so on. Also cost of infrastructure. Tariffs must be approved by a board of directors and the supervisory board'.*
- *'All rules and regulations must be approved by the Port's Board of Commissioners at a public meeting'.*
- *'Our tariffs are developed by finance section, approved by CEO and Board and then by the Minister'.*
- *'Our port tariff formulation and revision include review of prevailing market rates domestically and regionally, for similar services offered at competitor Ports'.*
    - *a) Increased costs in wages and salaries due to recent settlement of wage negotiations which have driven operational costs in Port higher.*
    - *b) remaining competitive by using a conservative increase,*
    - *c) Settlement of Labour Contracts with Unions which will reduce operational costs through higher efficiency Impact to the Shipping Lines costs and*
    - *d) Maintenance of and acquisition of new equipment and infrastructure'.*
- *'Approval Procedure Submission of the under-mentioned documents for Board approval, then to the Ministry of Transport for concurrence (a) Amended Draft Tariff, (b) an amendment sheet highlighting the amendments to the written section of the tariff, (c) Comparative table of the proposed tariff changes to the previous year's tariff and (d) Tabular review of revenue impact on port's proposed tariff increase. Plan is to review tariff every six months, however last revision was completed in 2010. For 2014 tariff implementation subject to Ministerial concurrence'.*

- *'The port's competitive position and financial strength are reviewed as well as what other ports are doing'.*
- *'Revision of port tariffs must be approved by port authority assembly'.*

Similarly the views of respondents representing *commercialized port authority* on tariff formulation revision and approval procedure are given below.

- *'Next year tariffs are decided by the board of directors on November previous year and do the revision accordingly'*
- *'Port's published tariffs are reviewed on an annual basis and are approved by the port's Board in May of each year. The review of tariffs follows the guidelines outlined in port's Pricing Policy Statement and includes a process of engagement with port's stakeholders. Port's customers are informed of the new tariff rates at least one month prior to implementation of the revised rates'.*
- *'Tariffs are revised annually with regard to rate of return objectives and cost increases including finance costs, wages and other supplies. The changes to pricing are formulated and documented in the Port's Strategic Development Plan. This document is a budgeting / planning document with a 5 year horizon. The document is formulated with input from across the organisation and is approved by the Port's Executive and Board. It is then forwarded to the Department of Transport for review prior to submission to the Minister for Transport for approval and the concurrence of the Treasurer'.*
- *'The revision of our Tariff is normally considered annually. With that all economic issues are considered and approval must be given by the port's Board of Directors'.*
- *'Prepared by management and approved by the board'.*

The view of the respondents of *port department* regarding tariff design, revision and approval includes;

- *'According to the policy of the port Bureau'*
- *'To us, port tariff means port and light dues, and charges on the use of government marine facilities. All fees levied are based on schedules contained in legal provisions. Thus, amendment to the schedules has to go through legislative procedure'.*

- *'We try to develop cost based, with annual review, internally approved by CEO with ministerial endorsement'.*
- *'The Financial Branch of the government staff along with accounting expert looks after all fee schedules. Technical inputs will be given by respective departments such as Marine Department on port operation and Port Works Division of the Civil Engineering and Development Department on marine structures'.*

The responses from survey participants from a more corporatized port administrative model such as a *Port Corporation* include;

- *'Tariffs are reviewed regularly to ensure currency, using financial reports, market information and strategic planning. Reviews are completed; pricing set and then this is approved by our Board before roll-out to customers'.*
- *'Existing tariff structure is used for revision (items, rates) proposed by the Business & Operations Department based on the market and certain other conditions for consideration and approval by a committee of selected members (not permanent) chaired by the CEO normally annually but sometime on a as needed basis'.*
- *'Ideas are generated internally by the department that owns the tariff, then consultation with users takes place, then the proposed fee/change is revised for internal approval, by the Executive Committee or the Board, then notice of the fee/change is published, then the fee comes into effect'.*
- *'Under the Port Law, Pricing Regulatory Commission Price Law, domestic port charges on the adjustment notice requirements and standards," the nature and extent of the difference between port charges market competition, domestic port charges are subject to government pricing, government guidance and market adjusted, where cargo dues, vessel expenses (including pilotage fees, tug fees , parking fees) government pricing; cargo loading and unloading fees, service charges implemented regulated by the market'.*
- *'Vessel charges (tonnage, mooring and waste fee) according to public pricelist, contractual/individual prices with terminal operators depending on terminal specifics for land rent and cargo charge'.*
- *'Port tariff committee to check out port tariff pricing and structure'.*

Views of respondents of a *Public limited company* port authority on tariff formulation revision and approval procedure include;

- *'Internal committee works with Port operator to review tariff (based on CPI review, new investments, identification of new users, incentives to offer)'*
- *'Annual analysis of all factors, combined with annual budget procedures. Tariffs are presented to our user forum and subsequently approved by the Board'.*
- *'Schedule of fees and charges is formulated within the annual strategic development planning process, reviewed by the board of Directors, and then sent to the Minister for Transport and state Treasurer for approval. Treasury input is directed towards us meeting our dividend and efficiency targets'.*

Views of respondents of a *Private limited company* port authority on tariff formulation revision and approval procedure include;

- *'Tariffs are reviewed annually to allow for infrastructural growth, customer requirement and return required to shareholder'.*
- *'Use of consultants to design and review tariffs'*
- *'The pricing of tariffs for our port is led by the Chief Financial Officer. The process involves use of external consultants for market pricing and building blocks analysis. The results are submitted to the Board for their approval'.*
- *'Based on March Quarter State CPI adjustment. Financial year commencing 1st July'.*
- *'Based on CPI (December to December each year) for revised tariff applicable from July next year. Board approval is required for any tariff changes'.*

<u>RESPONSES TO E5.3</u>

The survey gathered the views of port mangers on the training requirement of the port authority in terms of tariff designing. Selected responses are summarized below.

- *'Need clear documented policy for formulation and How to implement pricing to achieve other objectives other than investment recovery, maintenance'.*
- *'We have that expertise and communicate heavily with other ports'.*
- *'Capabilities arise by virtue of professional qualifications held by senior managers'.*

- *'Not sure we need any training in this regard - we have a very competent Finance team backing our Commercial team. We are a very small operation (Executives of Six)'.*
- *'General formulation, strategy and good practices for high competitiveness in port tariff design and revision, for some management levels'.*
- *'Generally we rely on information in the Port Authorities Act and regulations and guidance and support from the Department of Transport'.*
- *'No specific training is conducted. A brief inquiry of* Ports in the general port *area for us is important'.*
- *'Market survey of port's infrastructure tariffs of competitive ports'.*
- *'More accurate approach to cost based prices'.*
- *'Need international seminars with best practices and its theoretical background'.*
- *'Need a good data base, analytical tools, experience workforce and the knowledge about other ports and the environment is required'.*
- *'Just need policy advice so we meet the needs of our shareholder (government)'.*
- *'Need a Pricing Estimator'.*
- *'Strategy* Development *Office of the* Port Authority *examines* right time and right *charge on various kinds of services'.*

APPENDIX III: ETHICS APPROVAL LETTER

Social Science Ethics Officer
Private Bag 01 Hobart
Tasmania 7001 Australia
Tel: (03) 6226 2763
Fax: (03) 6226 7148
Katherine.Shaw@utas.edu.au

HUMAN RESEARCH ETHICS COMMITTEE (TASMANIA) NETWORK

30 October 2013

Dr Hong-Oanh Nguyen
National Centre for Ports and Shipping
Locked Bag 1397

Student Researcher: Yapa Mahinda Bandara

Sent via email

Dear Dr Nguyen

Re: MINIMAL RISK ETHICS APPLICATION APPROVAL
Ethics Ref: **H0013589 - Seaport Infrastructure Pricing: Practical issues**

We are pleased to advise that acting on a mandate from the Tasmania Social Sciences HREC, the Chair of the committee considered and approved the above project on 29 October 2013.

This approval constitutes ethical clearance by the Tasmania Social Sciences Human Research Ethics Committee. The decision and authority to commence the associated research may be dependent on factors beyond the remit of the ethics review process. For example, your research may need ethics clearance from other organisations or review by your research governance coordinator or Head of Department. It is your responsibility to find out if the approval of other bodies or authorities is required. It is recommended that the proposed research should not commence until you have satisfied these requirements.

Please note that this approval is for four years and is conditional upon receipt of an annual Progress Report. Ethics approval for this project will lapse if a Progress Report is not submitted.

The following conditions apply to this approval. Failure to abide by these conditions may result in suspension or discontinuation of approval.

1. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval, to ensure the project is conducted as approved by the Ethics Committee, and to notify the Committee if any investigators are added to, or cease involvement with, the project.

2. Complaints: If any complaints are received or ethical issues arise during the course of the project, investigators should advise the Executive Officer of the Ethics Committee on 03 6226 7479 or human.ethics@utas.edu.au.

3. Incidents or adverse effects: Investigators should notify the Ethics Committee immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.

4. Amendments to Project: Modifications to the project must not proceed until approval is obtained from the Ethics Committee. Please submit an Amendment Form (available on our website) to notify the Ethics Committee of the proposed modifications.

5. Annual Report: Continued approval for this project is dependent on the submission of a Progress Report by the anniversary date of your approval. You will be sent a courtesy reminder closer to this date. **Failure to submit a Progress Report will mean that ethics approval for this project will lapse.**

6. Final Report: A Final Report and a copy of any published material arising from the project, either in full or abstract, must be provided at the end of the project.

Yours sincerely

Katherine Shaw
Ethics Officer
Tasmania Social Sciences HREC

APPENDIX IV: COMMANDS OF SEM REGRESSION


```
**the sample of 153 ports were considered after checking for outliers using Z value in excel. Observations with Z value greater tahn 3 were omitted i.e. 7 observations.
sample 1 153
read (wpdata153.shd) trfc trfb bl bd  cl cw cd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame
print trfc trfb bl bd
print cl cw cd q tf

*Descriptive statistics level data

stat trfc trfb bl bd cl cw cd q tf/ pcor

**OLS level data

*****OLS trfc
ols trfc trfb cl cw cd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog predict=E01

****OLS trfb
ols trfb trfc bl bd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog predict=E02

GENR ltrfc=LOG(trfc)
GENR ltrfb=LOG(trfb)
GENR lbl=LOG(bl)
GENR lbd=LOG(bd)
GENR lcl=LOG(cl)
GENR lcw=LOG(cw)
GENR lcd=LOG(cd)
GENR lq=LOG(q)
GENR ltf=LOG(tf)

print ltrfc ltrfb lbl lbd
print lcl lcw lcd lq ltf

*Descriptive statistics
stat ltrfc ltrfb lbl lbd lcl lcw lcd lq ltf/ pcor

*Multiple regression OLS with main Numeric variables adjusted for Heteroskedasticity, test of normality Jarque Bera test

****Log linear model -independant varables

ols trfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
ols trfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog

****Log linear model -dependant varables

ols ltrfc trfb cl cw cd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
ols ltrfb trfc bl bd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
```

```
*Log Log Model

ols ltrfc ltrfb lcl lcw lcd lq ltf / dn hetcov gf loglog

ols ltrfb ltrfc lbl lbd lq ltf / dn hetcov gf loglog

*OLS Main numeric with Dummy-port infrastructure managment

ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc/ dn hetcov gf loglog
ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc/ dn hetcov gf loglog

*OLS Main numeric with Dummy-Port goverance model

ols ltrfc ltrfb lcl lcw lcd lq ltf dpgll dpgs dpgsl / dn hetcov gf loglog
ols ltrfb ltrfc lbl lbd lq ltf dpgll dpgs dpgsl/ dn hetcov gf loglog

*OLS Main numeric with Dummy-port infrastructure managment and Port goverance model
ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl/ dn hetcov gf loglog
ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl/ dn hetcov gf loglog

*OLS Main numeric with Dummy-Port region
ols ltrfc ltrfb lcl lcw lcd lq ltf dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
ols ltrfb ltrfc lbl lbd lq ltf dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog

*OLS Main numeric with Dummy-port infrastructure managment and Port region
ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
*OLS Main numeric with Dummy-port goverance model and Port region
ols ltrfc ltrfb lcl lcw lcd lq ltf dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog
ols ltrfb ltrfc lbl lbd lq ltf dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog

*OLS Main numerical variables with All Dummies
ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog predict=E1
GENR E1=EXP(E1+$SIG2/2)
print ltrfc E01 E1

ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog predict=E2
GENR E2=EXP(E2+$SIG2/2)
print ltrfb E02 E2

***Estimating effect of dummy dpmpa on ltrfc


* Estimation
```

```
OLS ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame / dn hetcov loglog COEF=BETA STDERR=SE

* Estimate the percentage effect of dummy variable dpmpa on ltrfc
GEN1 C1=BETA:7
GEN1 SE1=SE:7
GEN1 G1= 100*(EXP(C1-SE1*SE1/2)-1)

* Estimate the percentage effect of dummy variable dpmpcr on ltrfc
GEN1 C2=BETA:8
GEN1 SE2=SE:8
GEN1 G2= 100*(EXP(C2-SE2*SE2/2)-1)

ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov gf loglog COEF=BETA STDERR=SE

* Estimate the percentage effect of dummy variable dprnwe on ltrfb
GEN1 C3=BETA:16
GEN1 SE3=SE:16
GEN1 G3= 100*(EXP(C3-SE3*SE3/2)-1)

**% change in channel/port dues for dummay varaible port authority
PRINT G1
**% change in channel/port dues for dummay varaible cport corporation
PRINT G2
**% cahnge in berth occupancy charge for dummay varaible port region north and west Europe
PRINT G3
end



*Simultaneous Equation 2stage least square
2sls ltrfc ltrfb (lcl lcw lcd lq ltf)/ dn gf rstat
2sls ltrfb ltrfc (lbl lbd lq ltf)/ dn gf rstat
*with dummy variables

2sls ltrfc ltrfb lcl lcw lcd lq ltf ( lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf
2sls ltrfb ltrfc lbl lbd lq ltf (lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf
**********************************************
2sls ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame ( lbl lbd lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf
2sls ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame (lbl lbd lcl lcd lq ltf  dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf

**ommiting ltrfb as it is found to be not endogenous

2sls ltrfc lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
```

```
 dprea dprna dprnwe dprsa dprwame (lbl lbd lcl lcw lcd lq ltf dpmpa dpmpcr
dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn
rstat gf
2sls ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf
dpraus dprea dprna dprnwe dprsa dprwame (lbl lbd lcl lcd lq ltf  dpmpa dpmpcr
dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn
rstat gf

*3stage leat square

system 2 lcl lcw lcd lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf
dpraus dprea dprna dprnwe dprsa dprwame/ dn
ols ltrfc ltrfb lcl lcw lcd  lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf
dpraus dprea dprna dprnwe dprsa dprwame
ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf
dpraus dprea dprna dprnwe dprsa dprwame
end

**Ommiting insignificant variable- lcw- and re-run 2SLS

2sls ltrfc ltrfb lcl lcd lbl lbd ltf ( lcl lcd lq ltf dpmpa dpmpcr dpmlc dpgll
 dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn
2sls ltrfb ltrfc lbl lq ltf (lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs
dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn
```

APPENDIX V: REGRESSION OUTPUTS

```
 Welcome to SHAZAM (Double Precision) v11.0 -  JUNE 201 Windows7 PAR=112400
 ...NOTE..CURRENT WORKING DIRECTORY IS: C:\Users\ybandara\Documents\Data Analysis
 |_**the sample of 153 ports were considered after checking for outliers using Z value in
excel. Observations with Z value greater
 |  tahn 3 were omitted i.&
 |_*e. 7 observations.
 |_sample 1 153
 |_read (wpdata153.shd) trfc trfb bl bd  cl cw cd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl
dpraf dpraus dprea dprna dprnwe dprsa d
 | prwame
 ...NOTE..UNIT 88 IS NOW ASSIGNED TO: wpdata153.shd
 ...NOTE..   22 VARIABLES AND      153 OBSERVATIONS STARTING AT OBS       1

 |_print trfc trfb bl bd
      TRFC           TRFB            BL              BD
    12.00000       10.00000       4735.000        10.00000
    2.000000       6.000000       1169.000        9.100000
    2.090000       3.490000       2731.000        12.00000
    18.71000       5.480000       1592.000        10.64000
    23.45000       4.730000       25238.00        10.00000
    23.45000       4.730000       10743.00        11.30000
    23.45000       4.730000       2859.000        13.50000
    23.45000       4.730000       6363.000        14.36000
    9.000000       30.00000       2254.000        10.61000
   0.2000000E-01  0.1000000E-01   2227.000        9.560000
    7.520000       4.180000       4203.000        14.00000
    31.39000      0.9100000       824.0000        11.56000
    9.030000       18.71000       597.0000        8.900000
    12.26000       16.13000       1476.000        10.70000
    9.320000       21.12000       2114.000        11.30000
    9.320000       16.77000       5600.000        13.60000
    22.00000       1.940000       861.0000        9.800000
    77.64000       6.210000       4750.000        12.50000
    67.70000       9.940000       2847.000        12.60000
    17.70000       7.200000       1905.000        8.710000
    46.58000       9.320000       1950.000        9.350000
    28.57000       9.690000       2697.000        10.98000
    53.45000       6.110000       721.0000        11.96000
    9.800000      0.4900000       716.0000        10.00000
    1.590000       4.810000       20000.00        14.20000
    9.200000       12.20000       12958.00        10.50000
    9.300000       17.10000       5922.000        10.00000
    2.140000       7.970000       6430.000        16.00000
    2.140000       2.940000       24003.00        12.00000
    2.060000       9.680000       8217.000        7.500000
    2.140000       7.970000       35179.00        8.280000
    2.140000       7.970000       26743.00        10.00000
    8.000000       3.900000       4915.000        13.00000
    16.43000       4.360000       18546.00        14.00000
    16.43000       4.360000       10023.00        10.48000
    5.740000       1.220000       21630.00        16.00000
   0.1900000      0.3100000       26135.00        13.00000
   0.1900000      0.3100000       7922.000        10.30000
   0.1900000      0.3100000       12329.00        13.00000
    3.370000      0.4200000       5805.000        14.00000
    28.11000      0.5100000       7688.000        8.200000
    11.60000      0.3100000       9194.000        11.00000
    11.60000      0.3100000       3759.000        10.00000
    25.00000       15.00000       4229.000        9.500000
    25.00000       23.00000       1583.000        8.780000
    71.00000       23.00000       15667.00        11.65000
    71.00000       24.00000       17331.00        11.14000
    31.00000       23.00000       690.0000        5.200000
    14.00000       15.00000       2981.000        10.50000
    17.57000       50.00000       1625.000        10.00000
    40.00000       10.00000       4998.000        10.60000
    12.30000       3.500000       2315.000        8.910000
    5.030000       6.220000       6963.000        8.600000
```

24.19000	0.8800000	2500.000	7.860000
1.110000	1.900000	8084.000	16.00000
19.20000	1.000000	5929.000	10.90000
5.130000	0.2800000	4743.000	12.00000
1.010000	1.440000	11250.00	12.40000
18.13000	7.650000	2900.000	11.00000
12.82000	51.28000	5601.000	11.30000
6.410000	70.51000	4800.000	15.50000
92.02000	4.690000	12867.00	10.70000
1.560000	3.540000	5815.000	10.40000
3.850000	2.390000	9886.000	8.200000
2.180000	4.660000	3973.000	7.600000
5.150000	2.960000	2263.000	10.70000
1.820000	3.680000	5410.000	10.40000
2.080000	3.850000	894.0000	12.00000
12.91000	49.94000	2975.000	13.44000
2.080000	4.890000	1788.000	11.50000
14.67000	58.80000	16357.00	12.25000
34.40000	34.40000	14000.00	11.12000
5.850000	14.68000	6000.000	8.000000
5.680000	6.200000	1200.000	14.50000
1.900000	0.4100000	10145.00	12.24000
20.28000	21.88000	20911.00	7.900000
10.42000	5.880000	21672.00	10.78000
64.32000	32.16000	14720.00	9.400000
45.24000	20.24000	13818.00	8.600000
3.340000	8.140000	5000.000	7.900000
17.08000	3.170000	9729.000	10.46000
16.93000	2.620000	15448.00	8.500000
21.21000	12.00000	7200.000	9.800000
31.65000	1.850000	12000.00	18.60000
1.110000	28.48000	20000.00	20.00000
1.110000	28.48000	5181.000	9.500000
1.110000	28.48000	5275.000	10.00000
4.430000	29.62000	4515.000	8.750000
1.110000	29.62000	4690.000	11.03000
1.110000	29.62000	7690.000	10.20000
1.110000	26.89000	4922.000	10.45000
1.110000	25.06000	2000.000	8.750000
1.110000	22.78000	3154.000	9.650000
10.59000	130.4300	4100.000	13.12000
42.03000	17.39000	8640.000	10.20000
66.96000	96.96000	19429.00	11.60000
18.41000	134.7800	475.0000	9.500000
82.35000	13.53000	3049.000	11.43000
12.10000	24.20000	3474.000	6.600000
56.52000	11.26000	935.0000	5.500000
84.49000	107.2500	7323.000	8.500000
48.75000	66.23000	5920.000	8.340000
37.65000	94.12000	1725.000	18.00000
50.00000	71.43000	5767.000	11.46000
38.10000	61.90000	605.0000	4.600000
46.02000	35.71000	7000.000	8.600000
15.65000	9.410000	2833.000	9.400000
4.860000	7.310000	9922.000	9.000000
4.070000	5.320000	1246.000	9.700000
7.310000	6.370000	2260.000	9.120000
7.310000	6.780000	1075.000	7.740000
10.75000	8.040000	2030.000	8.700000
14.61000	3.240000	2930.000	7.900000
5.110000	18.06000	3728.000	10.56000
7.830000	10.02000	1870.000	8.140000
13.56000	3.260000	3214.000	9.380000
9.200000	5.470000	2232.000	9.580000
24.10000	25.00000	3533.000	8.300000
10.71000	4.440000	2660.000	12.50000
10.20000	7.100000	1722.000	11.50000
14.62000	6.100000	2105.000	12.78000

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  34.04000        5.620000        2532.000        10.30000
  12.00000        4.000000        3663.000        12.20000
  35.80000        9.100000        3180.000        11.18000
  20.14000        3.480000        3081.000        10.90000
  26.33000        4.440000        6059.000        11.80000
  14.30000        17.00000        3553.000        12.10000
  24.20000        2.850000        3471.000        12.00000
  20.47000        3.470000        5500.000        17.40000
  34.50000        34.50000        3538.000        9.400000
  56.00000        37.00000        1210.000        11.00000
  30.00000        8.000000        1679.000        12.00000
  26.00000        4.000000        4903.000        13.70000
  4.550000        2.640000        3172.000        15.00000
  4.350000        11.72000        524.0000        4.600000
  24.10000        3.000000        7460.000        7.000000
  20.47000        3.460000        900.0000        15.60000
  53.00000        14.00000        560.0000        15.00000
  52.08000        18.75000        3354.000        14.00000
  16.97000        16.08000        7285.000        10.15000
  21.00000        1.000000        3384.000        13.20000
  21.00000        1.000000        3300.000        12.67000
  22.00000        1.000000        9168.000        8.680000
  4.000000        1.000000        7570.000        11.20000
  5.280000        1.980000        1193.000        12.00000
  3.300000        1.600000        4435.000        14.90000
  3.180000       0.9600000        4753.000        12.00000
  13.30000        26.60000        4262.000        13.00000
  3.400000        2.550000        4372.000        13.00000
  54.00000        10.00000        2983.000        10.00000
  5.260000        3.510000        3240.000        12.20000
  70.50000        4.340000        5949.000        13.20000
  3.820000        2.340000        5740.000        15.00000
_print cl cw cd q tf
     CL              CW              CD               Q               TF
  3700.000        305.0000        15.00000       0.1641500E+08   0.1612877E+08
  3241.000        210.0000        14.95000        1476247.       0.1055800E+10
  1850.000        200.0000        12.80000        6295000.       0.7035403E+10
  6200.000        134.0000        12.80000        4795630.       0.7480525E+10
  7400.000        183.0000        12.80000       0.4140250E+08   0.1824220E+12
  2000.000        450.0000        15.90000        3205094.       0.1824220E+12
  3100.000        400.0000        23.70000       0.4653333E+08   0.1824220E+12
  3500.000        300.0000        19.50000       0.8453358E+08   0.1824220E+12
  870.0000        258.0000        14.00000        7948968.       0.2102206E+11
  1648.000        140.0000        10.20000        7795044.       0.1082108E+11
  9250.000        70.00000        15.50000       0.1029707E+08   0.3875300E+12
  3704.000        145.0000        12.20000        3665999.       0.3875300E+12
  1850.000        200.0000        12.90000        321357.0       0.3875300E+12
  18522.00        1481.000        12.20000        2729896.       0.3875300E+12
  10187.00        92.00000        10.67000        9833991.       0.3875300E+12
  3500.000        700.0000        13.20000        575496.0       0.3875300E+12
  14400.00        398.0000        23.20000        3602925.       0.3185791E+10
  1850.000        300.0000        12.50000       0.1200993E+08   0.6494944E+11
  8200.000        183.0000        14.10000       0.1352454E+08   0.6494944E+11
  3200.000        180.0000        7.500000        3454340.       0.6494944E+11
  2778.000        250.0000        11.60000        2050000.       0.6494944E+11
  2407.000        2000.000        11.60000       0.1228234E+08   0.6494944E+11
  9261.000        190.0000        14.70000        9000000.       0.6494944E+11
  130000.0        150.0000        9.500000        2093131.       0.9381480E+12
  70000.00        350.0000        10.00000       0.2805720E+09   0.2563260E+13
  3000.000        150.0000        14.00000       0.3988483E+08   0.2671440E+12
  46000.00        100.0000        9.700000       0.1103464E+08   0.2671440E+12
  14800.00        1400.000        24.00000       0.3495668E+08   0.1543950E+13
  4625.000        320.0000        15.00000       0.3735433E+08   0.1543950E+13
  9933.000        400.0000        14.00000       0.3672631E+08   0.1543950E+13
  23400.00        490.0000        15.00000       0.2838640E+08   0.1543950E+13
  3733.000        350.0000        14.00000       0.1959381E+08   0.1543950E+13
  6000.000        100.0000        11.50000       0.3001545E+08   0.1094970E+12
  1665.000        435.0000        20.40000       0.1346986E+09   0.8572820E+12
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40920.00	625.5000	14.00000	0.1785066E+08	0.8572820E+12
8000.000	160.0000	15.50000	0.2996974E+09	0.8204300E+12
18000.00	150.0000	16.00000	0.1533000E+09	0.4960770E+12
1850.000	355.0000	15.50000	0.4380000E+08	0.4960770E+12
750.0000	400.0000	16.00000	0.5220000E+08	0.4960770E+12
4625.000	300.0000	14.00000	0.4730000E+08	0.3570020E+12
18600.00	150.0000	11.00000	0.1680064E+08	0.3570020E+12
60000.00	1000.000	12.00000	5118126.	0.1433990E+12
79644.00	110.0000	14.00000	0.2020800E+08	0.1433990E+12
32000.00	300.0000	15.00000	0.1200310E+08	0.1122518E+11
6500.000	150.0000	9.200000	2057967.	0.1121643E+11
47231.00	3889.000	20.00000	0.1005223E+09	0.2563260E+13
2500.000	270.0000	10.00000	0.4550100E+08	0.2563260E+13
850.0000	60.00000	5.000000	475070.0	0.1121643E+11
1850.000	250.0000	14.00000	0.1010417E+08	0.2487530E+11
94622.00	122.0000	10.50000	8749550.	0.3767026E+11
97000.00	190.0000	13.80000	0.1267631E+08	0.1274800E+12
3200.000	95.00000	12.00000	3700000.	0.2824182E+11
2870.000	91.00000	12.80000	5568236.	0.9607707E+11
1850.000	120.0000	15.00000	0.2252895E+08	0.1187770E+12
2775.000	925.0000	30.00000	0.5054513E+08	0.7022960E+12
5556.000	250.0000	16.00000	0.2667200E+08	0.3339910E+12
1850.000	200.0000	10.60000	0.1604184E+08	0.1189610E+12
1050.000	250.0000	20.00000	0.3592281E+08	0.7022960E+12
1850.000	250.0000	17.00000	4655000.	0.1227659E+11
225968.0	700.0000	11.50000	7723000.	0.5927031E+11
1200.000	450.0000	18.60000	6771000.	0.5927031E+11
87000.00	244.0000	11.30000	0.2786655E+08	0.8754820E+12
4672.000	2000.000	18.00000	0.1028181E+08	0.8754820E+12
836.0000	89.00000	9.600000	0.1112869E+08	0.8754820E+12
200.0000	91.00000	11.80000	1402802.	0.8754820E+12
76000.00	670.0000	11.70000	2610000.	0.8754820E+12
2750.000	180.0000	9.100000	0.2558000E+08	0.8754820E+12
1853.000	450.0000	11.70000	2200000.	0.8754820E+12
1700.000	175.0000	16.00000	0.1899200E+08	0.6095690E+12
1162.000	280.0000	16.00000	0.2261758E+08	0.8754820E+12
32000.00	200.0000	13.00000	0.2702704E+08	0.9381480E+12
1850.000	150.0000	14.00000	0.1209800E+08	0.2262850E+12
1000.000	150.0000	8.000000	2850000.	0.2262850E+12
26.00000	462.5000	25.00000	850000.0	0.2848424E+11
1760.000	150.0000	14.00000	0.2907700E+08	0.2848424E+11
141000.0	350.0000	14.50000	0.1404000E+09	0.2631240E+13
90000.00	200.0000	14.00000	0.5990000E+08	0.2631240E+13
750.0000	200.0000	13.50000	0.1600000E+08	0.1218850E+13
22200.00	100.0000	15.00000	0.2956590E+08	0.2628683E+11
20374.00	1600.000	24.40000	0.5242835E+08	0.2620580E+12
2325.000	150.0000	11.50000	0.1778100E+08	0.3792620E+12
5300.000	150.0000	13.50000	0.1327500E+08	0.3792620E+12
27900.00	150.0000	11.60000	0.5040000E+08	0.7634670E+12
925.0000	500.0000	17.10000	0.5974364E+08	0.7022960E+12
4800.000	425.0000	22.00000	0.3939796E+08	0.7022960E+12
1200.000	120.0000	11.00000	5500000.	0.7022960E+12
600.0000	150.0000	11.50000	5438845.	0.7022960E+12
4167.000	160.0000	18.60000	0.1242874E+08	0.7022960E+12
700.0000	500.0000	18.50000	0.1933057E+08	0.7022960E+12
5000.000	490.0000	19.00000	0.1353081E+08	0.7022960E+12
3600.000	250.0000	13.00000	5007076.	0.7022960E+12
920.0000	103.0000	11.50000	4945449.	0.7022960E+12
960.0000	293.0000	14.00000	2800000.	0.7022960E+12
850.0000	463.0000	14.50000	0.2642000E+08	0.1093130E+13
16000.00	305.0000	17.00000	0.3723000E+08	0.1093130E+13
14880.00	1488.000	7.000000	0.2989000E+08	0.1093130E+13
2222.000	300.0000	9.500000	1132076.	0.1093130E+13
9261.000	150.0000	12.00000	9880000.	0.2096840E+12
800.0000	100.0000	9.000000	945216.0	0.1093130E+13
1850.000	90.00000	8.900000	34654.00	0.1093130E+13
12000.00	400.0000	9.100000	6632000.	0.1093130E+13
38896.00	360.0000	10.00000	3540000.	0.1093130E+13

42600.00	300.0000	18.00000	0.4030931E+08	0.2631240E+13
5500.000	150.0000	17.00000	0.2857000E+08	0.2628683E+11
3333.000	70.00000	9.400000	0.3363700E+08	0.2628683E+11
3000.000	100.0000	10.40000	4190000.	0.2628683E+11
29635.00	443.0000	11.00000	4100000.	0.2631240E+13
231.0000	500.0000	12.00000	5919000.	0.2620580E+12
300.0000	900.0000	24.40000	609000.0	0.2620580E+12
35191.00	800.0000	21.00000	2782246.	0.2620580E+12
230.0000	110.0000	12.50000	869732.0	0.2620580E+12
800.0000	500.0000	24.40000	2750000.	0.2620580E+12
7408.000	411.0000	10.00000	1773284.	0.2620580E+12
740.0000	350.0000	24.40000	6782000.	0.2620580E+12
1850.000	100.0000	11.00000	2955520.	0.2620580E+12
5000.000	200.0000	12.00000	6124140.	0.1515530E+12
1850.000	600.0000	12.40000	1994526.	0.1158741E+11
8787.000	203.0000	5.600000	0.3115076E+08	0.3922960E+11
7200.000	350.0000	11.00000	0.5728000E+08	0.5158600E+12
4550.000	380.0000	14.50000	2017000.	0.5158600E+12
7500.000	250.0000	14.40000	0.4168146E+08	0.5158600E+12
25000.00	200.0000	12.00000	0.7222500E+08	0.5158600E+12
20374.00	80.00000	7.900000	0.1404700E+08	0.5158600E+12
10500.00	175.0000	13.80000	0.1549400E+08	0.5158600E+12
2400.000	183.0000	14.70000	0.2201100E+08	0.5158600E+12
2000.000	122.0000	10.70000	0.6400000E+08	0.5158600E+12
7408.000	245.0000	15.40000	0.3669000E+08	0.5158600E+12
2720.000	190.0000	15.00000	0.4641000E+08	0.5158600E+12
7000.000	305.0000	19.20000	0.5749000E+08	0.5158600E+12
221000.0	45.00000	9.100000	0.1242800E+09	0.5158600E+12
10000.00	160.0000	14.00000	0.1452529E+08	0.5158600E+12
27900.00	175.0000	11.50000	0.2502300E+08	0.6265170E+11
11470.00	340.0000	13.50000	0.3873200E+08	0.6265170E+11
3237.000	230.0000	16.00000	0.2808600E+08	0.2240490E+11
150.0000	926.0000	35.00000	821876.0	0.1718900E+10
12400.00	900.0000	8.000000	1137826.	0.3922960E+11
12039.00	250.0000	22.00000	0.2050000E+09	0.5158600E+12
3775.000	250.0000	16.00000	0.1150000E+08	0.5158600E+12
3700.000	320.0000	18.00000	0.3572000E+08	0.5158600E+12
8890.000	366.0000	11.00000	0.5187600E+08	0.5158600E+12
8000.000	350.0000	13.72000	0.3070000E+08	0.7460526E+11
11400.00	300.0000	15.00000	0.1975000E+08	0.7460526E+11
3600.000	220.0000	14.00000	0.1912140E+08	0.7460526E+11
6475.000	240.0000	13.50000	0.3673940E+08	0.1710690E+12
3900.000	140.0000	11.50000	3149000.	0.1710690E+12
370.0000	1850.000	18.50000	3469000.	0.6085632E+11
4070.000	250.0000	11.50000	1230000.	0.4162130E+12
5500.000	280.0000	15.00000	0.1000000E+08	0.9520718E+11
19911.00	259.0000	15.00000	4900000.	0.4162130E+12
3000.000	300.0000	13.40000	7720340.	0.9427330E+11
1600.000	400.0000	24.40000	0.1695226E+08	0.2493268E+11
66679.00	300.0000	13.50000	0.4800000E+08	0.9520718E+11
22226.00	158.0000	15.00000	0.1990000E+08	0.4162130E+12

```
|_*Descriptive statistics level data
|_stat trfc trfb bl bd cl cw cd q tf/ pcor
NAME         N    MEAN         ST. DEV       VARIANCE     MINIMUM       MAXIMUM
TRFC         153   19.578       20.354        414.28       0.20000E-01   92.020
TRFB         153   15.826       23.255        540.80       0.10000E-01   134.78
BL           153   6353.2       6246.3       0.39016E+08   475.00        35179.
BD           153   10.992       2.5746        6.6285       4.6000        20.000
CL           153   16703.       34062.       0.11603E+10   26.000       0.22597E+06
CW           153   371.84       453.10       0.20530E+06   45.000        3889.0
CD           153   14.263       4.5512        20.714       5.0000        35.000
Q            153  0.27503E+08 0.43066E+08 0.18547E+16   34654.       0.29970E+09
TF           153  0.52340E+12 0.59620E+12 0.35546E+24  0.16129E+08  0.26312E+13

 CORRELATION MATRIX OF VARIABLES -      153 OBSERVATIONS


TRFC         1.0000
TRFB       0.26456       1.0000
BL        -0.35036E-03 -0.26149E-01   1.0000
BD        -0.43197E-01 -0.33144E-01  0.12057       1.0000
CL         0.12042      0.94162E-01  0.10772     -0.43268E-01   1.0000
CW         0.46334E-01  0.29762E-01  0.99825E-01  0.99706E-01  0.46673E-01
            1.0000
CD        -0.20089     -0.14047      0.17899E-01  0.35173     -0.15709
           0.31765      1.0000
Q         -0.51303E-02 -0.92248E-01  0.45156      0.35198      0.21975
           0.42256E-01  0.12443       1.0000
TF         0.71807E-01  0.22167      0.46597      0.80489E-01  0.22339
           0.21413     -0.27892E-01  0.35728       1.0000
              TRFC         TRFB         BL           BD           CL
              CW           CD           Q            TF
```

```
 |_**OLS level data
 |_*****OLS trfc

 |_ols trfc trfb cl cw cd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus c
dprna dprnwe dprsa dprwame/ dn hetcov gf log
 | log predict=E01

 REQUIRED MEMORY IS PAR=      57 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= TRFC
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.2612     R-SQUARE ADJUSTED =   0.1557
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   304.05
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   17.437
 SUM OF SQUARED ERRORS-SSE=   46520.
 MEAN OF DEPENDENT VARIABLE =   19.578
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -3649.95

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       343.80
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =    5.9786
  SCHWARZ (1978) CRITERION - LOG SC =                6.3748
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =            402.37
  HANNAN AND QUINN (1979) CRITERION =                463.85
  RICE (1984) CRITERION =                            411.68
  SHIBATA (1981) CRITERION =                         383.54
  SCHWARZ (1978) CRITERION - SC =                    586.85
  AKAIKE (1974) INFORMATION CRITERION - AIC =        394.90

                    ANALYSIS OF VARIANCE - FROM MEAN
                    SS          DF            MS                 F
 REGRESSION       16451.        19.         865.83             2.848
 ERROR            46520.       153.         304.05           P-VALUE
 TOTAL            62971.       152.         414.28             0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                    SS          DF            MS                 F
 REGRESSION       75098.        20.         3754.9            12.349
 ERROR            46520.       153.         304.05           P-VALUE
 TOTAL           0.12162E+06   153.         794.89             0.000


                            ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO       PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 TRFB      0.23187     0.9673E-01   2.397     0.017 0.204     0.2649     0.2319
 CL        0.48954E-04 0.5929E-04  0.8257     0.409 0.071     0.0819     0.0000
 CW        0.21254E-02 0.4954E-02  0.4290     0.668 0.037     0.0473     0.0021
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CD        -0.83868      0.2985      -2.810      0.005-0.237    -0.1875    -0.8387
Q          0.18217E-07 0.3356E-07  0.5428      0.587 0.047     0.0385     0.0000
TF        -0.46050E-13 0.3655E-11 -0.1260E-01 0.990-0.001    -0.0013     0.0000
DPMPA      -16.947       9.711      -1.745      0.081-0.150    -0.3898   -16.9472
DPMPCR     -11.872       10.94      -1.085      0.278-0.094    -0.1687   -11.8716
DPMLC      -5.8982       9.958     -0.5923      0.554-0.051    -0.1169    -5.8982
DPGLL      -4.5070       8.177     -0.5512      0.582-0.048    -0.1109    -4.5070
DPGS        5.9108       8.150      0.7253      0.468 0.063     0.1198     5.9108
DPGSL       2.7304       7.528      0.3627      0.717 0.031     0.0605     2.7304
DPRAF       2.5452       4.943      0.5149      0.607 0.045     0.0310     2.5452
DPRAUS      10.488       6.275       1.671      0.095 0.143     0.1441    10.4878
DPREA      0.45094       3.929      0.1148      0.909 0.010     0.0082     0.4509
DPRNA       3.9138       10.61      0.3688      0.712 0.032     0.0454     3.9138
DPRNWE      2.3807       4.957      0.4803      0.631 0.042     0.0541     2.3807
DPRSA       9.3123       4.702       1.981      0.048 0.169     0.1640     9.3123
DPRWAME     4.1353       6.340      0.6522      0.514 0.056     0.0568     4.1353
CONSTANT    35.822       11.25       3.185      0.001 0.266     0.0000    35.8217

DURBIN-WATSON = 1.8318    VON NEUMANN RATIO = 1.8438    RHO =  0.08248
RESIDUAL SUM =  0.89884E-12  RESIDUAL VARIANCE =   304.05
SUM OF ABSOLUTE ERRORS=   1988.1
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2612
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.0000
RUNS TEST:   59 RUNS,   59 POS,    0 ZERO,   94 NEG  NORMAL STATISTIC = -2.4825
COEFFICIENT OF SKEWNESS =   1.3667 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   2.8369 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   93.3796 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  0.0  0.0  0.0  0.0  1.0  0.0  0.0  4.0  2.0  8.0 11.0 19.0 18.0 16.0 15.0  9.0
0.0  7.0  6.0  9.0
          3.0  1.0  1.0  3.0  2.0  1.0  3.0  1.0  1.0  2.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
1.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   51.9760 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_****OLS trfb

 |_ols trfb trfc bl bd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna
dprnwe dprsa dprwame/ dn hetcov gf loglog
 |  predict=E02

 REQUIRED MEMORY IS PAR=      57 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= TRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3230     R-SQUARE ADJUSTED =   0.2321
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   363.73
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   19.072
 SUM OF SQUARED ERRORS-SSE=   55650.
 MEAN OF DEPENDENT VARIABLE =   15.826
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -3089.57

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      408.90
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =   6.1448
  SCHWARZ (1978) CRITERION - LOG SC =               6.5211
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           474.19
  HANNAN AND QUINN (1979) CRITERION =               543.29
  RICE (1984) CRITERION =                           483.92
  SHIBATA (1981) CRITERION =                        454.07
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 SCHWARZ (1978) CRITERION - SC =                    679.33
 AKAIKE (1974) INFORMATION CRITERION - AIC =        466.27

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF          MS                 F
REGRESSION        26551.         18.        1475.1              4.055
ERROR             55650.        153.        363.73            P-VALUE
TOTAL             82202.        152.        540.80              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF          MS                 F
REGRESSION        64873.         19.        3414.4              9.387
ERROR             55650.        153.        363.73            P-VALUE
TOTAL            0.12052E+06    153.        787.73              0.000


                            ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME     COEFFICIENT  ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
TRFC       0.33094    0.1096       3.020      0.003 0.252     0.2897     0.3309
BL        -0.57844E-03 0.3796E-03 -1.524      0.128-0.131    -0.1554    -0.0006
BD         0.90526    0.8034       1.127      0.260 0.097     0.1002     0.9053
Q         -0.58186E-07 0.3213E-07 -1.811      0.070-0.155    -0.1078     0.0000
TF         0.88600E-11 0.4438E-11  1.997      0.046 0.170     0.2271     0.0000
DPMPA       16.546     7.113       2.326      0.020 0.197     0.3331    16.5458
DPMPCR      11.574     7.231       1.600      0.109 0.137     0.1440    11.5737
DPMLC       13.925     7.318       1.903      0.057 0.162     0.2415    13.9253
DPGLL       1.8024     7.211      0.2500      0.803 0.022     0.0388     1.8024
DPGS       -6.8313     7.785     -0.8775      0.380-0.076    -0.1212    -6.8313
DPGSL      -1.8441     6.490     -0.2841      0.776-0.025    -0.0358    -1.8441
DPRAF      -6.5163     7.471     -0.8722      0.383-0.075    -0.0695    -6.5163
DPRAUS     -10.512     6.991      -1.504      0.133-0.129    -0.1265   -10.5119
DPREA      -7.5417     6.512      -1.158      0.247-0.100    -0.1203    -7.5417
DPRNA      -15.300     9.721      -1.574      0.116-0.135    -0.1553   -15.2999
DPRNWE      9.0167     7.516       1.200      0.230 0.103     0.1795     9.0167
DPRSA      -10.995     7.361      -1.494      0.135-0.128    -0.1695   -10.9947
DPRWAME    -12.206     7.060      -1.729      0.084-0.148    -0.1468   -12.2062
CONSTANT   -10.578     14.00     -0.7558      0.450-0.065     0.0000   -10.5782

DURBIN-WATSON = 1.6833    VON NEUMANN RATIO = 1.6944    RHO =  0.15769
RESIDUAL SUM = -0.26112E-12  RESIDUAL VARIANCE =   363.73
SUM OF ABSOLUTE ERRORS=   1946.4
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3230
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.0000
RUNS TEST:    56 RUNS,    57 POS,     0 ZERO,    96 NEG  NORMAL STATISTIC = -2.8691
COEFFICIENT OF SKEWNESS =    2.1131 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =    7.5500 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=  448.2487 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  0.0  0.0  0.0  0.0  1.0  1.0  0.0  2.0  1.0  7.0  6.0 15.0 22.0 19.0 22.0  9.0
15.0  9.0  2.0  7.0
          1.0  2.0  2.0  3.0  1.0  0.0  0.0  1.0  2.0  3.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   83.1002 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_GENR ltrfc=LOG(trfc)
 |_GENR ltrfb=LOG(trfb)
 |_GENR lbl=LOG(bl)
 |_GENR lbd=LOG(bd)
 |_GENR lcl=LOG(cl)
 |_GENR lcw=LOG(cw)
 |_GENR lcd=LOG(cd)
 |_GENR lq=LOG(q)
 |_GENR ltf=LOG(tf)
 |_print ltrfc ltrfb lbl lbd
```

LTRFC	LTRFB	LBL	LBD
2.484907	2.302585	8.462737	2.302585
0.6931472	1.791759	7.063904	2.208274
0.7371641	1.249902	7.912423	2.484907
2.929058	1.701105	7.372746	2.364620
3.154870	1.553925	10.13611	2.302585
3.154870	1.553925	9.282010	2.424803
3.154870	1.553925	7.958227	2.602690
3.154870	1.553925	8.758255	2.664447
2.197225	3.401197	7.720462	2.361797
-3.912023	-4.605170	7.708411	2.257588
2.017566	1.430311	8.343554	2.639057
3.446489	-0.9431068E-01	6.714171	2.447551
2.200552	2.929058	6.391917	2.186051
2.506342	2.780681	7.297091	2.370244
2.232163	3.050220	7.656337	2.424803
2.232163	2.819592	8.630522	2.610070
3.091042	0.6626880	6.758095	2.282382
4.352083	1.826161	8.465900	2.525729
4.215086	2.296567	7.954021	2.533697
2.873565	1.974081	7.552237	2.164472
3.841171	2.232163	7.575585	2.235376
3.352357	2.271094	7.899895	2.396075
3.978747	1.809927	6.580639	2.481568
2.282382	-0.7133499	6.573680	2.302585
0.4637340	1.570697	9.903488	2.653242
2.219203	2.501436	9.469469	2.351375
2.230014	2.839078	8.686430	2.302585
0.7608058	2.075684	8.768730	2.772589
0.7608058	1.078410	10.08593	2.484907
0.7227060	2.270062	9.013960	2.014903
0.7608058	2.075684	10.46820	2.113843
0.7608058	2.075684	10.19403	2.302585
2.079442	1.360977	8.500047	2.564949
2.799109	1.472472	9.828009	2.639057
2.799109	1.472472	9.212638	2.349469
1.747459	0.1988509	9.981837	2.772589
-1.660731	-1.171183	10.17103	2.564949
-1.660731	-1.171183	8.977399	2.332144
-1.660731	-1.171183	9.419709	2.564949
1.214913	-0.8675006	8.666475	2.639057
3.336125	-0.6733446	8.947416	2.104134
2.451005	-1.171183	9.126306	2.397895
2.451005	-1.171183	8.231908	2.302585
3.218876	2.708050	8.349721	2.251292
3.218876	3.135494	7.367077	2.172476
4.262680	3.135494	9.659312	2.455306
4.262680	3.178054	9.760252	2.410542
3.433987	3.135494	6.536692	1.648659
2.639057	2.708050	8.000014	2.351375
2.866193	3.912023	7.393263	2.302585
3.688879	2.302585	8.516793	2.360854
2.509599	1.252763	7.747165	2.187174
1.615420	1.827770	8.848366	2.151762
3.185939	-0.1278334	7.824046	2.061787
0.1043600	0.6418539	8.997642	2.772589
2.954910	0.0000000E+00	8.687611	2.388763
1.635106	-1.272966	8.464425	2.484907
0.9950331E-02	0.3646431	9.328123	2.517696
2.897568	2.034706	7.972466	2.397895
2.551006	3.937301	8.630700	2.424803
1.857859	4.255755	8.476371	2.740840
4.522006	1.545433	9.462421	2.370244
0.4446858	1.264127	8.668196	2.341806
1.348073	0.8712934	9.198875	2.104134
0.7793249	1.539015	8.287277	2.028148
1.638997	1.085189	7.724447	2.370244
0.5988365	1.302913	8.596004	2.341806

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3.182212      1.098612       8.917311      1.945910
3.018960      1.241269       6.802395      2.747271
3.970292      2.639057       6.327937      2.708050
3.952781      2.931194       8.117909      2.639057
2.831447      2.777576       8.893573      2.317474
3.044522     0.0000000E+00   8.126814      2.580217
3.044522     0.0000000E+00   8.101678      2.539237
3.091042     0.0000000E+00   9.123474      2.161022
1.386294     0.0000000E+00   8.931948      2.415914
1.663926     0.6830968       7.084226      2.484907
1.193922     0.4700036       8.397283      2.701361
1.156881    -0.4082199E-01   8.466531      2.484907
2.587764      3.280911       8.357494      2.564949
1.223775     0.9360934       8.382976      2.564949
3.988984      2.302585       8.000685      2.302585
1.660131      1.255616       8.083329      2.501436
4.255613      1.467874       8.690978      2.580217
1.340250     0.8501509       8.655214      2.708050
|_print lcl lcw lcd lq ltf
     LCL           LCW           LCD            LQ            LTF
   8.216088      5.720312      2.708050      16.61371      16.59611
   8.083637      5.347108      2.704711      14.20501      20.77756
   7.522941      5.298317      2.549445      15.65527      22.67422
   8.732305      4.897840      2.549445      15.38322      22.73557
   8.909235      5.209486      2.549445      17.53885      25.92959
   7.600902      6.109248      2.766319      14.98025      25.92959
   8.039157      5.991465      3.165475      17.65568      25.92959
   8.160518      5.703782      2.970414      18.25266      25.92959
   6.768493      5.552960      2.639057      15.88855      23.76884
   7.407318      4.941642      2.322388      15.86900      23.10476
   9.132379      4.248495      2.740840      16.14737      26.68306
   8.217169      4.976734      2.501436      15.11461      26.68306
   7.522941      5.298317      2.557227      12.68031      26.68306
   9.826714      7.300473      2.501436      14.81977      26.68306
   9.228868      4.521789      2.367436      16.10136      26.68306
   8.160518      6.551080      2.580217      13.26299      26.68306
   9.574983      5.986452      3.144152      15.09726      21.88197
   7.522941      5.703782      2.525729      16.30124      24.89687
   9.011889      5.209486      2.646175      16.42002      24.89687
   8.070906      5.192957      2.014903      15.05514      24.89687
   7.929487      5.521461      2.451005      14.53335      24.89687
   7.786136      7.600902      2.451005      16.32367      24.89687
   9.133567      5.247024      2.687847      16.01274      24.89687
   11.77529      5.010635      2.251292      14.55417      27.56717
   11.15625      5.857933      2.302585      19.45234      28.57230
   8.006368      5.010635      2.639057      17.50151      26.31105
   10.73640      4.605170      2.272126      16.21655      26.31105
   9.602382      7.244228      3.178054      17.36962      28.06537
   8.439232      5.768321      2.708050      17.43596      28.06537
   9.203618      5.991465      2.639057      17.41900      28.06537
   10.06049      6.194405      2.708050      17.16142      28.06537
   8.224967      5.857933      2.639057      16.79072      28.06537
   8.699515      4.605170      2.442347      17.21722      25.41916
   7.417580      6.075346      3.015535      18.71855      27.47703
   10.61937      6.438551      2.639057      16.69755      27.47703
   8.987197      5.075174      2.740840      19.51828      27.43309
   9.798127      5.010635      2.772589      18.84791      26.93000
   7.522941      5.872118      2.740840      17.59514      26.93000
   6.620073      5.991465      2.772589      17.77059      26.93000
   8.439232      5.703782      2.639057      17.67202      26.60101
   9.830917      5.010635      2.397895      16.63693      26.60101
   11.00210      6.907755      2.484907      15.44830      25.68890
   11.28532      4.700480      2.639057      16.82159      25.68890
   10.37349      5.703782      2.708050      16.30068      23.14143
   8.779557      5.010635      2.219203      14.53723      23.14065
   10.76281      8.265907      2.995732      18.42589      28.57230
   7.824046      5.598422      2.302585      17.63324      28.57230
   6.745236      4.094345      1.609438      13.07122      23.14065
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7.522941	5.521461	2.639057	16.12846	23.93714
11.45765	4.804021	2.351375	15.98451	24.35214
11.48247	5.247024	2.624669	16.35525	25.57123
8.070906	4.553877	2.484907	15.12384	24.06407
7.962067	4.510860	2.549445	15.53259	25.28842
7.522941	4.787492	2.708050	16.93031	25.50051
7.928406	6.829794	3.401197	17.73838	27.27762
8.622634	5.521461	2.772589	17.09912	26.53438
7.522941	5.298317	2.360854	16.59071	25.50206
6.956545	5.521461	2.995732	17.39688	27.27762
7.522941	5.521461	2.833213	15.35345	23.23096
12.32815	6.551080	2.442347	15.85971	24.80537
7.090077	6.109248	2.923162	15.72816	24.80537
11.37366	5.497168	2.424803	17.14294	27.49804
8.449343	7.600902	2.890372	16.14589	27.49804
6.728629	4.488636	2.261763	16.22504	27.49804
5.298317	4.510860	2.468100	14.15398	27.49804
11.23849	6.507278	2.459589	14.77486	27.49804
7.919356	5.192957	2.208274	17.05732	27.49804
7.524561	6.109248	2.459589	14.60397	27.49804
7.438384	5.164786	2.772589	16.75953	27.13602
7.057898	5.634790	2.772589	16.93424	27.49804
10.37349	5.298317	2.564949	17.11235	27.56717
7.522941	5.010635	2.639057	16.30855	26.14506
6.907755	5.010635	2.079442	14.86283	26.14506
3.258097	6.136647	3.218876	13.65299	24.07262
7.473069	5.010635	2.639057	17.18546	24.07262
11.85652	5.857933	2.674149	18.76001	28.59848
11.40756	5.298317	2.639057	17.90819	28.59848
6.620073	5.298317	2.602690	16.58810	27.82893
10.00785	4.605170	2.708050	17.20213	23.99233
9.922015	7.377759	3.194583	17.77496	26.29183
7.751475	5.010635	2.442347	16.69364	26.66149
8.575462	5.010635	2.602690	16.40139	26.66149
10.23638	5.010635	2.451005	17.73550	27.36114
6.829794	6.214608	2.839078	17.90557	27.27762
8.476371	6.052089	3.091042	17.48922	27.27762
7.090077	4.787492	2.397895	15.52026	27.27762
6.396930	5.010635	2.442347	15.50908	27.27762
8.334952	5.075174	2.923162	16.33552	27.27762
6.551080	6.214608	2.917771	16.77720	27.27762
8.517193	6.194405	2.944439	16.42048	27.27762
8.188689	5.521461	2.564949	15.42636	27.27762
6.824374	4.634729	2.442347	15.41398	27.27762
6.866933	5.680173	2.639057	14.84513	27.27762
6.745236	6.137727	2.674149	17.08963	27.72007
9.680344	5.720312	2.833213	17.43263	27.72007
9.607773	7.305188	1.945910	17.21303	27.72007
7.706163	5.703782	2.251292	13.93956	27.72007
9.133567	5.010635	2.484907	16.10602	26.06887
6.684612	4.605170	2.197225	13.75917	27.72007
7.522941	4.499810	2.186051	10.45317	27.72007
9.392662	5.991465	2.208274	15.70742	27.72007
10.56865	5.886104	2.302585	15.07964	27.72007
10.65961	5.703782	2.890372	17.51209	28.59848
8.612503	5.010635	2.833213	17.16787	23.99233
8.111628	4.248495	2.240710	17.33114	23.99233
8.006368	4.605170	2.341806	15.24821	23.99233
10.29671	6.093570	2.397895	15.22650	28.59848
5.442418	6.214608	2.484907	15.59368	26.29183
5.703782	6.802395	3.194583	13.31957	26.29183
10.46855	6.684612	3.044522	14.83877	26.29183
5.438079	4.700480	2.525729	13.67594	26.29183
6.684612	6.214608	3.194583	14.82711	26.29183
8.910316	6.018593	2.302585	14.38834	26.29183
6.606650	5.857933	3.194583	15.72978	26.29183
7.522941	4.605170	2.397895	14.89919	26.29183
8.517193	5.298317	2.484907	15.62775	25.74420

9.392662	5.991465	2.208274	15.70742	27.72007
10.56865	5.886104	2.302585	15.07964	27.72007
10.65961	5.703782	2.890372	17.51209	28.59848
8.612503	5.010635	2.833213	17.16787	23.99233
8.111628	4.248495	2.240710	17.33114	23.99233
8.006368	4.605170	2.341806	15.24821	23.99233
10.29671	6.093570	2.397895	15.22650	28.59848
5.442418	6.214608	2.484907	15.59368	26.29183
5.703782	6.802395	3.194583	13.31957	26.29183
10.46855	6.684612	3.044522	14.83877	26.29183
5.438079	4.700480	2.525729	13.67594	26.29183
6.684612	6.214608	3.194583	14.82711	26.29183
8.910316	6.018593	2.302585	14.38834	26.29183
6.606650	5.857933	3.194583	15.72978	26.29183
7.522941	4.605170	2.397895	14.89919	26.29183
8.517193	5.298317	2.484907	15.62775	25.74420
7.522941	6.396930	2.517696	14.50592	23.17318
9.081029	5.313206	1.722767	17.25435	24.39270
8.881836	5.857933	2.397895	17.86346	26.96910
8.422883	5.940171	2.674149	14.51712	26.96910
8.922658	5.521461	2.667228	17.54557	26.96910
10.12663	5.298317	2.484907	18.09530	26.96910
9.922015	4.382027	2.066863	16.45792	26.96910
9.259131	5.164786	2.624669	16.55596	26.96910
7.783224	5.209486	2.687847	16.90705	26.96910
7.600902	4.804021	2.370244	17.97439	26.96910
8.910316	5.501258	2.734368	17.41801	26.96910
7.908387	5.247024	2.708050	17.65303	26.96910
8.853665	5.720312	2.954910	17.86712	26.96910
12.30592	3.806662	2.208274	18.63805	26.96910
9.210340	5.075174	2.639057	16.49140	26.96910
10.23638	5.164786	2.442347	17.03531	24.86086
9.347490	5.828946	2.602690	17.47218	24.86086
8.082402	5.438079	2.772589	17.15078	23.83255
5.010635	6.830874	3.555348	13.61934	21.26495
9.425452	6.802395	2.079442	13.94463	24.39270
9.395907	5.521461	3.091042	19.13852	26.96910
8.236156	5.521461	2.772589	16.25786	26.96910
8.216088	5.768321	2.890372	17.39122	26.96910
9.092682	5.902633	2.397895	17.76437	26.96910
8.987197	5.857933	2.618855	17.23977	25.03548
9.341369	5.703782	2.708050	16.79866	25.03548
8.188689	5.393628	2.639057	16.76632	25.03548
8.775704	5.480639	2.602690	17.41936	25.86533
8.268732	4.941642	2.442347	14.96260	25.86533
5.913503	7.522941	2.917771	15.05938	24.83178
8.311398	5.521461	2.442347	14.02252	26.75446
8.612503	5.634790	2.708050	16.11810	25.27932
9.899028	5.556828	2.708050	15.40475	26.75446
8.006368	5.703782	2.595255	15.85937	25.26946
7.377759	5.991465	3.194583	16.64591	23.93945
11.10765	5.703782	2.602690	17.68671	25.27932
10.00902	5.062595	2.708050	16.80623	26.75446

:Descriptive statistics

```
|_*Descriptive statistics
|_stat ltrfc ltrfb lbl lbd lcl lcw lcd lq ltf/ pcor
NAME         N    MEAN        ST. DEV      VARIANCE      MINIMUM       MAXIMUM
LTRFC       153   2.3038       1.3991       1.9574       -3.9120        4.5220
LTRFB       153   1.9062       1.4718       2.1662       -4.6052        4.9036
LBL         153   8.3438      0.93690      0.87778        6.1633        10.468
LBD         153   2.3693      0.24129      0.58222E-01    1.5261        2.9957
LCL         153   8.5363       1.5541       2.4151        3.2581        12.328
LCW         153   5.5657      0.76391      0.58356        3.8067        8.2659
LCD         153   2.6116      0.30256      0.91541E-01    1.6094        3.5553
LQ          153   16.279       1.4583       2.1266        10.453        19.518
LTF         153   26.115       1.7588       3.0933        16.596        28.598

 CORRELATION MATRIX OF VARIABLES -      153 OBSERVATIONS


LTRFC       1.0000
LTRFB      0.39649       1.0000
LBL       -0.13520     -0.82444E-01   1.0000
LBD       -0.75411E-01 -0.15982      0.21396       1.0000
LCL        0.29614      0.20628E-01  0.19707      0.10381       1.0000
LCW       -0.84734E-01  0.21061E-01  0.14895      0.23236      0.25706E-01
            1.0000
LCD       -0.20042     -0.96897E-01  0.53609E-01  0.39142     -0.18557
           0.43595      1.0000
LQ         0.12300E-01 -0.11942      0.55473      0.47316      0.36032
           0.30481E-01  0.21917      1.0000
LTF       -0.70020E-01  0.10597      0.33978      0.18451      0.17551
           0.95002E-01 -0.30748E-01  0.25285       1.0000
              LTRFC        LTRFB        LBL          LBD          LCL
              LCW          LCD          LQ           LTF

 |_*Multiple regression OLS with main Numeric variables adjusted for Heteroskedasticity,
test of normality Jarque Bera test
 |_****Log linear model -independant varables

 |_ols trfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
dprea dprna dprnwe dprsa dprwame/ dn hetcov
 | gf loglog

 REQUIRED MEMORY IS PAR=      70 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= TRFC
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3364     R-SQUARE ADJUSTED =   0.2416
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   273.11
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   16.526
 SUM OF SQUARED ERRORS-SSE=   41786.
 MEAN OF DEPENDENT VARIABLE =   19.578
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -3641.74

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      308.81
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =   5.8713
  SCHWARZ (1978) CRITERION - LOG SC =               6.2675
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           361.43
  HANNAN AND QUINN (1979) CRITERION =               416.65
  RICE (1984) CRITERION =                           369.79
  SHIBATA (1981) CRITERION =                        344.51
  SCHWARZ (1978) CRITERION - SC =                   527.13
  AKAIKE (1974) INFORMATION CRITERION - AIC =       354.72

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF             MS                 F
 REGRESSION        21185.        19.          1115.0             4.082
 ERROR             41786.        153.         273.11            P-VALUE
 TOTAL             62971.        152.         414.28             0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF             MS                 F
 REGRESSION        79831.        20.          3991.6            14.615
 ERROR             41786.        153.         273.11            P-VALUE
 TOTAL           0.12162E+06    153.          794.89             0.000
```

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO --------	P-VALUE	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS
LTRFB	3.9738	0.9183	4.327	0.000	0.351	0.2873	3.9738
LCL	2.6626	1.224	2.176	0.030	0.185	0.2033	2.6626
LCW	-0.47300	2.098	-0.2254	0.822	-0.020	-0.0178	-0.4730
LCD	-12.185	5.756	-2.117	0.034	-0.181	-0.1811	-12.1853
LQ	3.0502	1.117	2.730	0.006	0.230	0.2185	3.0502
LTF	-0.78342	0.8805	-0.8898	0.374	-0.077	-0.0677	-0.7834
DPMPA	-23.169	10.87	-2.131	0.033	-0.182	-0.5329	-23.1691
DPMPCR	-19.580	12.07	-1.622	0.105	-0.139	-0.2783	-19.5803
DPMLC	-12.840	10.92	-1.176	0.240	-0.101	-0.2544	-12.8402
DPGLL	-5.4547	6.941	-0.7859	0.432	-0.068	-0.1342	-5.4547
DPGS	6.7595	7.228	0.9352	0.350	0.081	0.1370	6.7595
DPGSL	2.1067	6.356	0.3314	0.740	0.029	0.0467	2.1067
DPRAF	0.86186	4.822	0.1787	0.858	0.015	0.0105	0.8619
DPRAUS	9.9102	6.188	1.602	0.109	0.138	0.1362	9.9102
DPREA	-1.7618	4.427	-0.3980	0.691	-0.034	-0.0321	-1.7618
DPRNA	5.9853	9.659	0.6197	0.535	0.054	0.0694	5.9853
DPRNWE	3.3139	4.768	0.6950	0.487	0.060	0.0754	3.3139
DPRSA	3.3223	4.879	0.6810	0.496	0.059	0.0585	3.3223
DPRWAME	3.8034	5.635	0.6749	0.500	0.058	0.0523	3.8034
CONSTANT	12.393	25.94	0.4777	0.633	0.041	0.0000	12.3925

```
DURBIN-WATSON = 1.7580    VON NEUMANN RATIO = 1.7696    RHO =  0.11476
RESIDUAL SUM = -0.23199E-11  RESIDUAL VARIANCE =   273.11
SUM OF ABSOLUTE ERRORS=   1912.9
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3364
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.0000
RUNS TEST:   63 RUNS,   67 POS,    0 ZERO,   86 NEG  NORMAL STATISTIC = -2.1950
COEFFICIENT OF SKEWNESS =   1.2002 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   2.1329 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   62.1537 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  0.0  0.0  0.0  0.0  0.0  1.0  1.0  4.0  3.0  6.0 12.0 19.0 18.0  9.0 13.0 15.0
'.0 13.0  8.0  5.0
          2.0  4.0  3.0  1.0  1.0  1.0  2.0  1.0  1.0  3.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
.1.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   53.4119 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.000
```

```
 |_ols trfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame/ dn hetcov gf l
 | oglog

 REQUIRED MEMORY IS PAR=      68 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= TRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.2910     R-SQUARE ADJUSTED =   0.1957
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   380.94
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   19.518
 SUM OF SQUARED ERRORS-SSE=   58284.
 MEAN OF DEPENDENT VARIABLE =   15.826
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -3093.11

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      428.24
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =   6.1910
  SCHWARZ (1978) CRITERION - LOG SC =               6.5673
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           496.62
  HANNAN AND QUINN (1979) CRITERION =               569.00
  RICE (1984) CRITERION =                           506.81
  SHIBATA (1981) CRITERION =                        475.55
  SCHWARZ (1978) CRITERION - SC =                   711.47
  AKAIKE (1974) INFORMATION CRITERION - AIC =       488.34

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS           DF            MS                   F
 REGRESSION        23918.         18.         1328.8                3.488
 ERROR             58284.        153.         380.94              P-VALUE
 TOTAL             82202.        152.         540.80                0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS           DF            MS                   F
 REGRESSION        62240.         19.         3275.8                8.599
 ERROR             58284.        153.         380.94              P-VALUE
 TOTAL            0.12052E+06    153.         787.73                0.000
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                                    ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC      4.4452      1.249       3.560     0.000 0.294    0.2674      4.4452
 LBL       -5.2395      3.235      -1.620     0.105-0.139   -0.2111     -5.2395
 LBD        8.4907      9.251      0.9178     0.359 0.079    0.0881      8.4907
 LQ        0.44101      1.396      0.3159     0.752 0.027    0.0277      0.4410
 LTF        1.3392      1.201       1.115     0.265 0.096    0.1013      1.3392
 DPMPA      11.214      8.106       1.383     0.167 0.119    0.2257     11.2143
 DPMPCR     8.8461      8.184       1.081     0.280 0.093    0.1100      8.8461
 DPMLC      12.279      8.193       1.499     0.134 0.128    0.2129     12.2787
 DPGLL      5.9717      8.301      0.7194     0.472 0.062    0.1286      5.9717
 DPGS      -2.5048      8.469     -0.2958     0.767-0.026   -0.0444     -2.5048
 DPGSL      1.7928      7.444      0.2408     0.810 0.021    0.0348      1.7928
 DPRAF     -3.6331      8.332     -0.4360     0.663-0.038   -0.0387     -3.6331
 DPRAUS    -12.692      7.442      -1.706     0.088-0.146   -0.1527    -12.6923
 DPREA     -4.8632      6.232     -0.7803     0.435-0.067   -0.0776     -4.8632
 DPRNA     -8.9031      8.680      -1.026     0.305-0.088   -0.0904     -8.9031
 DPRNWE     12.806      7.568       1.692     0.091 0.145    0.2549     12.8063
 DPRSA     -12.983      7.459      -1.741     0.082-0.149   -0.2002    -12.9829
 DPRWAME   -11.691      6.855      -1.706     0.088-0.146   -0.1406    -11.6911
 CONSTANT  -25.014      32.12     -0.7788     0.436-0.067    0.0000    -25.0142

 DURBIN-WATSON = 1.4529    VON NEUMANN RATIO = 1.4625    RHO =  0.27182
 RESIDUAL SUM = -0.31974E-13  RESIDUAL VARIANCE =   380.94
 SUM OF ABSOLUTE ERRORS=   2042.8
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2910
 R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.0000
 RUNS TEST:   48 RUNS,   64 POS,     0 ZERO,   89 NEG  NORMAL STATISTIC = -4.5773
 COEFFICIENT OF SKEWNESS =   1.9108 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =   6.0150 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=  304.3480 P-VALUE= 0.000

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  0.0  0.0  0.0  0.0  0.0  0.0  2.0  2.0  6.0  6.0  8.0 13.0 19.0 15.0 18.0 14.0
14.0 10.0  8.0  3.0
           3.0  2.0  1.0  2.0  0.0  2.0  0.0  0.0  0.0  5.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   86.4251 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_****Log linear model -dependant varables

 |_ols ltrfc trfb cl cw cd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame/ dn hetcov gf lo
 | glog

 REQUIRED MEMORY IS PAR=      70 CURRENT PAR=  112400
  OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.2811     R-SQUARE ADJUSTED =   0.1784
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3980
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1824
 SUM OF SQUARED ERRORS-SSE=   213.89
 MEAN OF DEPENDENT VARIABLE =   2.3038
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -595.207

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5807
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.59645
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 SCHWARZ (1978) CRITERION - LOG SC =            0.99259
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =         1.8500
 HANNAN AND QUINN (1979) CRITERION =             2.1327
 RICE (1984) CRITERION =                         1.8928
 SHIBATA (1981) CRITERION =                      1.7634
 SCHWARZ (1978) CRITERION - SC =                 2.6982
 AKAIKE (1974) INFORMATION CRITERION - AIC =     1.8157

                     ANALYSIS OF VARIANCE - FROM MEAN
                   SS          DF            MS                 F
REGRESSION      83.640         19.        4.4021              3.149
ERROR           213.89        153.        1.3980            P-VALUE
TOTAL           297.53        152.        1.9574              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                   SS          DF            MS                 F
REGRESSION      895.69         20.        44.784             32.036
ERROR           213.89        153.        1.3980            P-VALUE
TOTAL           1109.6        153.        7.2521              0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
TRFB       0.13455E-01 0.3700E-02   3.637     0.000 0.301     0.2237    0.0135
CL         0.62994E-05 0.3446E-05   1.828     0.068 0.157     0.1534    0.0000
CW         0.34644E-04 0.2458E-03  0.1409     0.888 0.012     0.0112    0.0000
CD        -0.52025E-01 0.2309E-01  -2.253     0.024-0.192    -0.1692   -0.0520
Q         -0.20729E-09 0.3038E-08 -0.6823E-01 0.946-0.006    -0.0064    0.0000
TF        -0.13549E-12 0.2137E-12 -0.6341     0.526-0.055    -0.0577    0.0000
DPMPA     -0.75029     0.5333      -1.407     0.159-0.121    -0.2510   -0.7503
DPMPCR    -0.62190     0.6339     -0.9811     0.327-0.085    -0.1286   -0.6219
DPMLC     -0.19614     0.5079     -0.3862     0.699-0.033    -0.0565   -0.1961
DPGLL     -0.38183     0.4127     -0.9252     0.355-0.080    -0.1367   -0.3818
DPGS       0.84417E-01 0.4701      0.1796     0.857 0.016     0.0249    0.0844
DPGSL      0.14454     0.4167      0.3469     0.729 0.030     0.0466    0.1445
DPRAF     -0.23338     0.7270     -0.3210     0.748-0.028    -0.0414   -0.2334
DPRAUS     0.77600     0.3788       2.048     0.041 0.175     0.1552    0.7760
DPREA     -0.27114     0.4000     -0.6779     0.498-0.059    -0.0719   -0.2711
DPRNA     -0.38276     0.4879     -0.7845     0.433-0.068    -0.0646   -0.3828
DPRNWE    -0.27241E-01 0.3425     -0.7955E-01 0.937-0.007    -0.0090   -0.0272
DPRSA      0.75506     0.3243       2.328     0.020 0.198     0.1935    0.7551
DPRWAME    0.21182     0.4027      0.5260     0.599 0.046     0.0424    0.2118
CONSTANT   3.4119      0.6597       5.172     0.000 0.409     0.0000    3.4119

DURBIN-WATSON = 1.4553    VON NEUMANN RATIO = 1.4648    RHO =  0.27045
RESIDUAL SUM = -0.62172E-13  RESIDUAL VARIANCE =   1.3980
SUM OF ABSOLUTE ERRORS=   137.34
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2811
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1301
RUNS TEST:   72 RUNS,   78 POS,    0 ZERO,   75 NEG  NORMAL STATISTIC = -0.8878
COEFFICIENT OF SKEWNESS =  -1.0415 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   3.5481 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=  100.5651 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  2.0  1.0  0.0  1.0  0.0  0.0  1.0  7.0  3.0  5.0  7.0  9.0 13.0 12.0 14.0  9.0
13.0 15.0 12.0  7.0
          5.0  7.0  6.0  3.0  0.0  0.0  1.0  0.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   27.7850 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.001

|_ols ltrfb trfc bl bd q tf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna
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dprnwe dprsa dprwame/ dn hetcov gf loglo
 | g

 REQUIRED MEMORY IS PAR=      68 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3434     R-SQUARE ADJUSTED =   0.2552
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.4131
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1887
 SUM OF SQUARED ERRORS-SSE=   216.20
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -535.203

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5886
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.59413
  SCHWARZ (1978) CRITERION - LOG SC =              0.97046
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           1.8422
  HANNAN AND QUINN (1979) CRITERION =               2.1107
  RICE (1984) CRITERION =                           1.8800
  SHIBATA (1981) CRITERION =                        1.7640
  SCHWARZ (1978) CRITERION - SC =                   2.6392
  AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8115

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF           MS                 F
 REGRESSION        113.07        18.        6.2814             4.445
 ERROR             216.20       153.        1.4131           P-VALUE
 TOTAL             329.27       152.        2.1662             0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF           MS                 F
 REGRESSION        669.03        19.        35.212            24.919
 ERROR             216.20       153.        1.4131           P-VALUE
 TOTAL             885.23       153.        5.7858             0.000


                            ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME     COEFFICIENT  ERROR    --------    P-VALUE CORR. COEFFICIENT  AT MEANS
 TRFC       0.19689E-01 0.4384E-02   4.492      0.000 0.362      0.2723    0.0197
 BL        -0.18900E-04 0.1778E-04  -1.063      0.288-0.091     -0.0802    0.0000
 BD        -0.23393E-01 0.4454E-01 -0.5252      0.599-0.045     -0.0409   -0.0234
 Q         -0.37591E-08 0.1962E-08  -1.915      0.055-0.163     -0.1100    0.0000
 TF         0.59393E-12 0.1978E-12   3.003      0.003 0.251      0.2406    0.0000
 DPMPA      0.57809     0.3297       1.753      0.080 0.150      0.1839    0.5781
 DPMPCR     0.39366     0.4785      0.8227      0.411 0.071      0.0774    0.3937
 DPMLC      0.37949     0.3322       1.142      0.253 0.098      0.1040    0.3795
 DPGLL     -0.24271     0.2781     -0.8728      0.383-0.075     -0.0826   -0.2427
 DPGS      -0.74784     0.4188      -1.786      0.074-0.152     -0.2097   -0.7478
 DPGSL     -0.35504     0.2764      -1.284      0.199-0.110     -0.1088   -0.3550
 DPRAF     -0.32874     0.7933     -0.4144      0.679-0.036     -0.0554   -0.3287
 DPRAUS     0.17576     0.5742      0.3061      0.760 0.026      0.0334    0.1758
 DPREA     -0.64212     0.6001      -1.070      0.285-0.092     -0.1618   -0.6421
 DPRNA     -0.58493     0.6583     -0.8886      0.374-0.077     -0.0938   -0.5849
 DPRNWE     0.69812     0.5241       1.332      0.183 0.114      0.2195    0.6981
 DPRSA      0.39278E-01 0.5297      0.7415E-01 0.941 0.006      0.0096    0.0393
 DPRWAME   -0.70761     0.5559      -1.273      0.203-0.109     -0.1345   -0.7076
 CONSTANT   1.5456      0.7826       1.975      0.048 0.168      0.0000    1.5456

 DURBIN-WATSON = 1.4983    VON NEUMANN RATIO = 1.5082    RHO =  0.24629
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RESIDUAL SUM = -0.16209E-13  RESIDUAL VARIANCE =   1.4131
SUM OF ABSOLUTE ERRORS=   136.46
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3434
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.3351
RUNS TEST:   47 RUNS,   80 POS,    0 ZERO,    73 NEG  NORMAL STATISTIC = -4.9323
COEFFICIENT OF SKEWNESS =  -0.6158 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   2.1713 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   36.5865 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  1.0  0.0  1.0  1.0  0.0  4.0  2.0  4.0  4.0  4.0  7.0  3.0 15.0 12.0 15.0 16.0
1.0 12.0 17.0  5.0
          4.0  5.0  1.0  4.0  2.0  1.0  1.0  1.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
1.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   27.0700 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.001
|_*Log Log Model

|_ols ltrfc ltrfb lcl lcw lcd lq ltf / dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      52 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.2815     R-SQUARE ADJUSTED =   0.2519
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3973
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1821
SUM OF SQUARED ERRORS-SSE=   213.78
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -595.170

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.4612
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.42603
 SCHWARZ (1978) CRITERION - LOG SC =             0.56468
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =            1.5345
 HANNAN AND QUINN (1979) CRITERION =                1.6199
 RICE (1984) CRITERION =                            1.5380
 SHIBATA (1981) CRITERION =                         1.5251
 SCHWARZ (1978) CRITERION - SC =                    1.7589
 AKAIKE (1974) INFORMATION CRITERION - AIC =        1.5312

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF             MS                 F
REGRESSION        83.743         6.         13.957               9.989
ERROR             213.78        153.        1.3973             P-VALUE
TOTAL             297.53        152.        1.9574               0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF             MS                 F
REGRESSION        895.79         7.         127.97              91.585
ERROR             213.78        153.        1.3973             P-VALUE
TOTAL             1109.6        153.        7.2521               0.000


                            ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.38218     0.1016       3.761      0.000 0.297      0.4020      0.3822
LCL       0.26381     0.6644E-01   3.970      0.000 0.312      0.2930      0.2638
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LCW      -0.78068E-01 0.1201     -0.6500     0.516-0.054    -0.0426    -0.0781
LCD      -0.45345     0.3237     -1.401      0.161-0.115    -0.0981    -0.4535
LQ        0.19205E-01 0.7424E-01  0.2587     0.796 0.021     0.0200     0.0192
LTF      -0.13371     0.5666E-01 -2.360      0.018-0.192    -0.1681    -0.1337
CONSTANT  4.1213      2.000       2.061      0.039 0.168     0.0000     4.1213

DURBIN-WATSON = 1.2283    VON NEUMANN RATIO = 1.2364    RHO =  0.38254
RESIDUAL SUM =  0.26290E-12  RESIDUAL VARIANCE =   1.3973
SUM OF ABSOLUTE ERRORS=   142.55
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2815
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1024
RUNS TEST:   53 RUNS,   82 POS,     0 ZERO,    71 NEG  NORMAL STATISTIC = -3.9308
COEFFICIENT OF SKEWNESS =  -0.5256 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.1587 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    6.9892 P-VALUE= 0.030

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  1.0  8.0  6.0  7.0 16.0 17.0 33.0 19.0 17.0 20.0  6.0  2.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   22.1666 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.001

|_ols ltrfb ltrfc lbl lbd lq ltf / dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      51 CURRENT PAR=  112400
 OLS ESTIMATION
     153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.2107     R-SQUARE ADJUSTED =   0.1838
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6987
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3033
SUM OF SQUARED ERRORS-SSE=   259.90
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -549.286

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.7653
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.60829
 SCHWARZ (1978) CRITERION - LOG SC =             0.72713
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8402
 HANNAN AND QUINN (1979) CRITERION =               1.9282
 RICE (1984) CRITERION =                           1.8433
 SHIBATA (1981) CRITERION =                        1.8319
 SCHWARZ (1978) CRITERION - SC =                   2.0691
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8373

                     ANALYSIS OF VARIANCE - FROM MEAN
                    SS          DF             MS                   F
REGRESSION        69.366         5.         13.873                8.167
ERROR             259.90       153.         1.6987              P-VALUE
TOTAL             329.27       152.         2.1662                0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                    SS          DF             MS                   F
REGRESSION        625.33         6.         104.22               61.354
ERROR             259.90       153.         1.6987              P-VALUE
TOTAL             885.23       153.         5.7858                0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------    P-VALUE CORR. COEFFICIENT  AT MEANS
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LTRFC     0.42359      0.1057       4.008      0.000 0.314     0.4027     0.4236
LBL      -0.23032E-02 0.1496      -0.1539E-01 0.988-0.001    -0.0015    -0.0023
LBD      -0.64963      0.5317      -1.222      0.222-0.100    -0.1065    -0.6496
LQ       -0.12096      0.9396E-01  -1.287      0.198-0.106    -0.1198    -0.1210
LTF       0.15450      0.7243E-01   2.133      0.033 0.173     0.1846     0.1545
CONSTANT  0.42306       1.856       0.2279     0.820 0.019     0.0000     0.4231

DURBIN-WATSON = 1.1644    VON NEUMANN RATIO = 1.1720    RHO =  0.41160
RESIDUAL SUM = -0.34261E-12  RESIDUAL VARIANCE =   1.6987
SUM OF ABSOLUTE ERRORS=   154.90
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2107
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.0735
RUNS TEST:   50 RUNS,   73 POS,     0 ZERO,    80 NEG  NORMAL STATISTIC = -4.4446
COEFFICIENT OF SKEWNESS =  -0.1976 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.1125 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    1.0069 P-VALUE= 0.604

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  4.0  3.0  4.0 11.0 14.0 27.0 29.0 20.0 16.0  7.0 14.0  1.0  2.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   21.3107 WITH  7 DEGREES OF FREEDOM, P-VALUE= 0.003
|_*OLS Main numeric with Dummy-port infrastructure managment

|_ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      56 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3243     R-SQUARE ADJUSTED =   0.2818
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3140
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1463
SUM OF SQUARED ERRORS-SSE=   201.04
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -590.468

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.3999
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.40377
 SCHWARZ (1978) CRITERION - LOG SC =             0.60184
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          1.5042
 HANNAN AND QUINN (1979) CRITERION =              1.6229
 RICE (1984) CRITERION =                          1.5116
 SHIBATA (1981) CRITERION =                       1.4857
 SCHWARZ (1978) CRITERION - SC =                  1.8255
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.4975

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS           DF             MS                F
REGRESSION         96.489          9.          10.721             8.159
ERROR              201.04        153.          1.3140           P-VALUE
TOTAL              297.53        152.          1.9574             0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS           DF             MS                F
REGRESSION         908.54         10.          90.854            69.144
ERROR              201.04        153.          1.3140           P-VALUE
TOTAL              1109.6        153.          7.2521             0.000

                             ASYMPTOTIC
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VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.35393     0.1038       3.410     0.001 0.274     0.3723     0.3539
LCL       0.26851     0.6836E-01   3.928     0.000 0.312     0.2983     0.2685
LCW      -0.14813     0.1113      -1.331     0.183-0.111    -0.0809    -0.1481
LCD      -0.46177     0.3379      -1.367     0.172-0.114    -0.0999    -0.4618
LQ        0.33793E-01 0.7011E-01  0.4820     0.630 0.040     0.0352     0.0338
LTF      -0.14828     0.5428E-01  -2.732     0.006-0.223    -0.1864    -0.1483
DPMPA     -1.0636     0.5983      -1.778     0.075-0.147    -0.3559    -1.0636
DPMPCR    -1.1321     0.6664      -1.699     0.089-0.141    -0.2341    -1.1321
DPMLC    -0.42644     0.6084     -0.7009     0.483-0.059    -0.1229    -0.4264
CONSTANT  5.6027       2.017       2.778     0.005 0.226     0.0000     5.6027

DURBIN-WATSON = 1.3184    VON NEUMANN RATIO = 1.3271    RHO =  0.33739
RESIDUAL SUM =  0.12790E-12  RESIDUAL VARIANCE =   1.3140
SUM OF ABSOLUTE ERRORS=   137.42
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3243
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1279
RUNS TEST:   57 RUNS,   84 POS,     0 ZERO,    69 NEG  NORMAL STATISTIC = -3.2377
COEFFICIENT OF SKEWNESS =  -0.6073 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.4502 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   10.2246 P-VALUE= 0.006

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  2.0  7.0  6.0  8.0 13.0 17.0 30.0 28.0 16.0 17.0  5.0  2.0  1.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   15.2073 WITH  3 DEGREES OF FREEDOM, P-VALUE= 0.002

|_ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=       55 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS      DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:       1,     153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =    0.2198      R-SQUARE ADJUSTED =    0.1765
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.6790
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.2958
SUM OF SQUARED ERRORS-SSE=    256.89
MEAN OF DEPENDENT VARIABLE =    1.9062
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -548.395

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.7778
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.63586
 SCHWARZ (1978) CRITERION - LOG SC =              0.81412
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =            1.8955
 HANNAN AND QUINN (1979) CRITERION =                2.0305
 RICE (1984) CRITERION =                            1.9029
 SHIBATA (1981) CRITERION =                         1.8766
 SCHWARZ (1978) CRITERION - SC =                    2.2572
 AKAIKE (1974) INFORMATION CRITERION - AIC =        1.8886

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                  F
REGRESSION        72.375          8.        9.0468              5.388
ERROR             256.89        153.        1.6790            P-VALUE
TOTAL             329.27        152.        2.1662              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                  F
REGRESSION        628.34          9.        69.815             41.581
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ERROR            256.89         153.         1.6790                P-VALUE
TOTAL            885.23         153.         5.7858                  0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.40634     0.1105       3.678     0.000 0.293     0.3863     0.4063
LBL       0.94309E-02 0.1496      0.6303E-01 0.950 0.005     0.0060     0.0094
LBD      -0.61913     0.5513      -1.123     0.261-0.093    -0.1015    -0.6191
LQ       -0.12970     0.9617E-01  -1.349     0.177-0.112    -0.1285    -0.1297
LTF       0.15229     0.7168E-01   2.124     0.034 0.174     0.1820     0.1523
DPMPA     0.24500     0.4441      0.5517     0.581 0.046     0.0779     0.2450
DPMPCR   -0.68181E-01 0.5657     -0.1205     0.904-0.010    -0.0134    -0.0682
DPMLC     0.46734     0.4624       1.011     0.312 0.084     0.1280     0.4673
CONSTANT  0.23770      1.953      0.1217     0.903 0.010     0.0000     0.2377

DURBIN-WATSON = 1.1987    VON NEUMANN RATIO = 1.2066    RHO =  0.39435
RESIDUAL SUM = -0.24913E-12  RESIDUAL VARIANCE =   1.6790
SUM OF ABSOLUTE ERRORS=   156.37
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2198
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1019
RUNS TEST:   52 RUNS,   74 POS,     0 ZERO,    79 NEG  NORMAL STATISTIC = -4.1279
COEFFICIENT OF SKEWNESS =  -0.1913 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0314 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    0.9452 P-VALUE= 0.623

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  3.0  4.0  4.0 11.0 17.0 24.0 28.0 18.0 19.0  9.0 12.0  2.0  1.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   10.9150 WITH  4 DEGREES OF FREEDOM, P-VALUE= 0.028
|_*OLS Main numeric with Dummy-Port goverance model

|_ols ltrfc ltrfb lcl lcw lcd lq ltf dpgll dpgs dpgsl / dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      56 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3442     R-SQUARE ADJUSTED =   0.3030
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.2752
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1293
SUM OF SQUARED ERRORS-SSE=   195.11
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -588.177

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.3586
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.37383
 SCHWARZ (1978) CRITERION - LOG SC =              0.57190
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.4598
 HANNAN AND QUINN (1979) CRITERION =               1.5751
 RICE (1984) CRITERION =                           1.4670
 SHIBATA (1981) CRITERION =                        1.4419
 SCHWARZ (1978) CRITERION - SC =                   1.7716
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.4533

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                   F
REGRESSION       102.42          9.         11.380                 8.924
ERROR            195.11         153.         1.2752                P-VALUE
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TOTAL             297.53        152.         1.9574                0.000

                   ANALYSIS OF VARIANCE - FROM ZERO
                       SS         DF              MS                 F
REGRESSION        914.47         10.         91.447               71.711
ERROR             195.11        153.         1.2752              P-VALUE
TOTAL             1109.6        153.         7.2521                0.000


                               ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.39147     0.1051       3.723     0.000 0.297     0.4118     0.3915
LCL       0.27984     0.6218E-01   4.500     0.000 0.352     0.3108     0.2798
LCW      -0.70600E-01 0.1064     -0.6635     0.507-0.055    -0.0385    -0.0706
LCD      -0.51788     0.3161      -1.638     0.101-0.136    -0.1120    -0.5179
LQ        0.44602E-01 0.6934E-01  0.6433     0.520 0.054     0.0465     0.0446
LTF      -0.99930E-01 0.5693E-01  -1.755     0.079-0.145    -0.1256    -0.0999
DPGLL     -1.0671     0.3342      -3.193     0.001-0.258    -0.3820    -1.0671
DPGS     -0.33050     0.3816     -0.8660     0.386-0.072    -0.0975    -0.3305
DPGSL    -0.46833     0.3382      -1.385     0.166-0.115    -0.1510    -0.4683
CONSTANT   3.5029      2.038       1.719     0.086 0.142     0.0000     3.5029

DURBIN-WATSON = 1.3695    VON NEUMANN RATIO = 1.3785    RHO =  0.31051
RESIDUAL SUM =  0.21760E-12  RESIDUAL VARIANCE =   1.2752
SUM OF ABSOLUTE ERRORS=   133.14
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3442
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1853
RUNS TEST:   69 RUNS,   81 POS,     0 ZERO,    72 NEG  NORMAL STATISTIC = -1.3406
COEFFICIENT OF SKEWNESS =  -0.5707 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.8106 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   11.6830 P-VALUE= 0.003

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  2.0  1.0  6.0  4.0  8.0 16.0 21.0 31.0 19.0 23.0  9.0 11.0  2.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   17.0562 WITH  3 DEGREES OF FREEDOM, P-VALUE= 0.001

|_ols ltrfb ltrfc lbl lbd lq ltf dpgll dpgs dpgsl/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      55 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.2481     R-SQUARE ADJUSTED =   0.2063
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6181
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2721
SUM OF SQUARED ERRORS-SSE=   247.57
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -545.569

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.7133
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.59892
 SCHWARZ (1978) CRITERION - LOG SC =              0.77718
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8267
 HANNAN AND QUINN (1979) CRITERION =               1.9568
 RICE (1984) CRITERION =                           1.8339
 SHIBATA (1981) CRITERION =                        1.8085
 SCHWARZ (1978) CRITERION - SC =                   2.1753
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8201
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                    ANALYSIS OF VARIANCE - FROM MEAN
                    SS              DF              MS                  F
REGRESSION       81.692             8.           10.211               6.311
ERROR            247.57           153.           1.6181             P-VALUE
TOTAL            329.27           152.           2.1662               0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                    SS              DF              MS                  F
REGRESSION       637.65             9.           70.850              43.785
ERROR            247.57           153.           1.6181             P-VALUE
TOTAL            885.23           153.           5.7858               0.000


                                ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      0.44434    0.9783E-01   4.542     0.000 0.354     0.4224     0.4443
LBL      -0.22552E-01 0.1379     -0.1636     0.870-0.014    -0.0144    -0.0226
LBD      -0.66509     0.5080      -1.309     0.190-0.108    -0.1090    -0.6651
LQ       -0.15009     0.8990E-01  -1.670     0.095-0.138    -0.1487    -0.1501
LTF       0.11485     0.7418E-01   1.548     0.122 0.128     0.1372     0.1149
DPGLL    -0.58352E-01 0.2690     -0.2169     0.828-0.018    -0.0199    -0.0584
DPGS     -0.83487     0.3121      -2.675     0.007-0.218    -0.2341    -0.8349
DPGSL    -0.26497     0.2407      -1.101     0.271-0.091    -0.0812    -0.2650
CONSTANT  2.3724       1.879       1.263     0.207 0.105     0.0000     2.3724

DURBIN-WATSON = 1.1495    VON NEUMANN RATIO = 1.1571    RHO =  0.41736
RESIDUAL SUM = -0.60618E-12  RESIDUAL VARIANCE =   1.6181
SUM OF ABSOLUTE ERRORS=   150.74
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2481
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1446
RUNS TEST:   54 RUNS,   74 POS,    0 ZERO,   79 NEG  NORMAL STATISTIC = -3.8031
COEFFICIENT OF SKEWNESS =  -0.2235 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.2573 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    1.5298 P-VALUE= 0.465

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  2.0  3.0  3.0  4.0  6.0 18.0 30.0 24.0 26.0 11.0  9.0 12.0  4.0  1.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   19.4580 WITH  4 DEGREES OF FREEDOM, P-VALUE= 0.001
|_*OLS Main numeric with Dummy-port infrastructure managment and Port goverance model

|_ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl/ dn hetcov gf
loglog

REQUIRED MEMORY IS PAR=      60 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3753     R-SQUARE ADJUSTED =   0.3218
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.2148
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1022
SUM OF SQUARED ERRORS-SSE=   185.86
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -584.463

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.3180
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.36449
 SCHWARZ (1978) CRITERION - LOG SC =             0.62198
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
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   GENERALIZED CROSS VALIDATION - GCV =          1.4509
HANNAN AND QUINN (1979) CRITERION =              1.5985
RICE (1984) CRITERION =                          1.4635
SHIBATA (1981) CRITERION =                       1.4212
SCHWARZ (1978) CRITERION - SC =                  1.8626
AKAIKE (1974) INFORMATION CRITERION - AIC =      1.4398

                     ANALYSIS OF VARIANCE - FROM MEAN
                   SS          DF            MS                 F
REGRESSION       111.67        12.         9.3055              7.660
ERROR            185.86       153.         1.2148             P-VALUE
TOTAL            297.53       152.         1.9574              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                   SS          DF            MS                 F
REGRESSION       923.71        13.         71.055             58.492
ERROR            185.86       153.         1.2148             P-VALUE
TOTAL            1109.6       153.         7.2521              0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.37091     0.1056      3.513      0.000 0.285    0.3902     0.3709
LCL        0.27679     0.6319E-01  4.380      0.000 0.347    0.3075     0.2768
LCW       -0.14568     0.1033     -1.410      0.158-0.118   -0.0795    -0.1457
LCD       -0.46748     0.3286     -1.423      0.155-0.119   -0.1011    -0.4675
LQ         0.53205E-01 0.6785E-01  0.7842     0.433 0.066    0.0555     0.0532
LTF       -0.11125     0.5432E-01 -2.048      0.041-0.171   -0.1399    -0.1113
DPMPA     -0.98069     0.5631     -1.742      0.082-0.146   -0.3281    -0.9807
DPMPCR    -0.94056     0.6363     -1.478      0.139-0.124   -0.1945    -0.9406
DPMLC     -0.36678     0.5399     -0.6794     0.497-0.057   -0.1057    -0.3668
DPGLL     -0.54860     0.3435     -1.597      0.110-0.134   -0.1964    -0.5486
DPGS       0.16785     0.3648      0.4601     0.645 0.039    0.0495     0.1678
DPGSL      0.73499E-01 0.3507      0.2096     0.834 0.018    0.0237     0.0735
CONSTANT   4.3333      2.006       2.160      0.031 0.180    0.0000     4.3333

DURBIN-WATSON = 1.4308    VON NEUMANN RATIO = 1.4402    RHO =  0.27994
RESIDUAL SUM =  0.12434E-12  RESIDUAL VARIANCE =    1.2148
SUM OF ABSOLUTE ERRORS=   129.33
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3753
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.2207
RUNS TEST:   67 RUNS,   88 POS,    0 ZERO,   65 NEG  NORMAL STATISTIC = -1.4560
COEFFICIENT OF SKEWNESS =  -0.6727 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   1.0345 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   17.2135 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
OBSERVED  2.0  0.0  2.0  2.0  7.0  5.0  7.0 11.0 15.0 14.0 29.0 19.0 11.0 13.0  8.0  5.0
.0  0.0  0.0  0.0

EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
.8  1.5  0.7  0.5

CHI-SQUARE =   20.7833 WITH  5 DEGREES OF FREEDOM, P-VALUE= 0.001

|_ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      59 CURRENT PAR=  112400
 OLS ESTIMATION
     153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:       1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =    0.2591     R-SQUARE ADJUSTED =    0.2013
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.5944
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STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2627
SUM OF SQUARED ERRORS-SSE=   243.94
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -544.439

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.7195
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.62336
 SCHWARZ (1978) CRITERION - LOG SC =              0.86104
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8773
 HANNAN AND QUINN (1979) CRITERION =               2.0542
 RICE (1984) CRITERION =                           1.8910
 SHIBATA (1981) CRITERION =                        1.8445
 SCHWARZ (1978) CRITERION - SC =                   2.3656
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8652

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF             MS                  F
REGRESSION        85.322         11.         7.7566                4.865
ERROR             243.94        153.         1.5944              P-VALUE
TOTAL             329.27        152.         2.1662                0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF             MS                  F
REGRESSION        641.28         12.         53.440               33.518
ERROR             243.94        153.         1.5944              P-VALUE
TOTAL             885.23        153.         5.7858                0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      0.43170     0.1009       4.277     0.000 0.339     0.4104     0.4317
LBL       -0.95109E-02 0.1377     -0.6907E-01 0.945-0.006    -0.0061    -0.0095
LBD       -0.60697     0.5200      -1.167     0.243-0.098    -0.0995    -0.6070
LQ        -0.16401     0.9343E-01  -1.755     0.079-0.146    -0.1625    -0.1640
LTF        0.11398     0.7250E-01   1.572     0.116 0.131     0.1362     0.1140
DPMPA      0.37660     0.3685       1.022     0.307 0.086     0.1198     0.3766
DPMPCR    -0.42383E-01 0.4946     -0.8569E-01 0.932-0.007    -0.0083    -0.0424
DPMLC      0.53447     0.3516       1.520     0.128 0.127     0.1464     0.5345
DPGLL     -0.62649E-01 0.3178     -0.1971     0.844-0.017    -0.0213    -0.0626
DPGS      -0.86543     0.3577      -2.420     0.016-0.200    -0.2426    -0.8654
DPGSL     -0.27374     0.3198     -0.8561     0.392-0.072    -0.0839    -0.2737
CONSTANT   2.0550       1.868       1.100     0.271 0.092     0.0000     2.0550

DURBIN-WATSON = 1.1905    VON NEUMANN RATIO = 1.1984    RHO =  0.39666
RESIDUAL SUM = -0.42788E-12  RESIDUAL VARIANCE =   1.5944
SUM OF ABSOLUTE ERRORS=   152.07
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2591
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1769
RUNS TEST:    56 RUNS,    76 POS,     0 ZERO,    77 NEG  NORMAL STATISTIC = -3.4875
COEFFICIENT OF SKEWNESS =  -0.2368 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.1112 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=     1.4317 P-VALUE= 0.489

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  2.0  3.0  2.0  5.0  6.0 21.0 29.0 20.0 25.0 11.0 15.0  9.0  4.0  1.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =    16.6450 WITH  1 DEGREES OF FREEDOM, P-VALUE= 0.000
|_*OLS Main numeric with Dummy-Port region

 |_ols ltrfc ltrfb lcl lcw lcd lq ltf dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn
hetcov gf loglog
```

```
REQUIRED MEMORY IS PAR=      61 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3605     R-SQUARE ADJUSTED =   0.3007
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.2436
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1152
SUM OF SQUARED ERRORS-SSE=   190.27
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -586.256

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.3574
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.40101
 SCHWARZ (1978) CRITERION - LOG SC =             0.67831
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          1.5067
 HANNAN AND QUINN (1979) CRITERION =              1.6714
 RICE (1984) CRITERION =                          1.5222
 SHIBATA (1981) CRITERION =                       1.4712
 SCHWARZ (1978) CRITERION - SC =                  1.9705
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.4933

                     ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF            MS                  F
REGRESSION          107.26         13.         8.2506              6.634
ERROR               190.27        153.         1.2436            P-VALUE
TOTAL               297.53        152.         1.9574              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                       SS          DF            MS                  F
REGRESSION          919.30         14.         65.665             52.802
ERROR               190.27        153.         1.2436            P-VALUE
TOTAL               1109.6        153.         7.2521              0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.35990     0.1089       3.306      0.001 0.270      0.3786     0.3599
LCL       0.24371     0.6586E-01   3.700      0.000 0.299      0.2707     0.2437
LCW      -0.65671E-01 0.1211      -0.5424     0.588-0.046     -0.0359    -0.0657
LCD      -0.49284     0.3295      -1.496      0.135-0.126     -0.1066    -0.4928
LQ        0.37577E-01 0.8064E-01  0.4660      0.641 0.039      0.0392     0.0376
LTF      -0.11096     0.5301E-01  -2.093      0.036-0.175     -0.1395    -0.1110
DPRAF    -0.29360     0.5970      -0.4918     0.623-0.042     -0.0520    -0.2936
DPRAUS    0.81904     0.3889       2.106      0.035 0.176      0.1638     0.8190
DPREA    -0.33232     0.3867      -0.8594     0.390-0.073     -0.0881    -0.3323
DPRNA    -0.37712     0.4440      -0.8494     0.396-0.072     -0.0636    -0.3771
DPRNWE    0.58600E-02 0.3478       0.1685E-01 0.987 0.001      0.0019     0.0059
DPRSA     0.66428     0.3245       2.047      0.041 0.171      0.1702     0.6643
DPRWAME   0.40788     0.3878       1.052      0.293 0.089      0.0816     0.4079
CONSTANT   3.3658      1.744       1.930      0.054 0.162      0.0000     3.3658

DURBIN-WATSON = 1.3428    VON NEUMANN RATIO = 1.3517    RHO =  0.32670
RESIDUAL SUM =  0.12257E-12  RESIDUAL VARIANCE =   1.2436
SUM OF ABSOLUTE ERRORS=   138.08
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3605
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1203
RUNS TEST:   63 RUNS,   81 POS,     0 ZERO,   72 NEG  NORMAL STATISTIC = -2.3174
COEFFICIENT OF SKEWNESS =  -0.3581 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.1170 WITH STANDARD DEVIATION OF 0.3898
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 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    3.2411 P-VALUE= 0.198

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
 OBSERVED  1.0  1.0  1.0  6.0  4.0  3.0  9.0 15.0 19.0 13.0 15.0 24.0 15.0 12.0  4.0  6.0
4.0  1.0  0.0  0.0

 EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
2.8  1.5  0.7  0.5

 CHI-SQUARE =   17.4420 WITH  4 DEGREES OF FREEDOM, P-VALUE= 0.002

 |_ols ltrfb ltrfc lbl lbd lq ltf dpraf dpraus dprea dprna dprnwe dprsa dprwame/ dn hetcov
gf loglog

 REQUIRED MEMORY IS PAR=      60 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3504     R-SQUARE ADJUSTED =   0.2947
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3980
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1824
 SUM OF SQUARED ERRORS-SSE=   213.90
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -534.385

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.5168
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.50501
  SCHWARZ (1978) CRITERION - LOG SC =              0.76250
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =          1.6697
  HANNAN AND QUINN (1979) CRITERION =              1.8397
  RICE (1984) CRITERION =                          1.6843
  SHIBATA (1981) CRITERION =                       1.6356
  SCHWARZ (1978) CRITERION - SC =                  2.1436
  AKAIKE (1974) INFORMATION CRITERION - AIC =      1.6570

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF          MS                  F
 REGRESSION        115.36         12.        9.6137              6.877
 ERROR             213.90        153.        1.3980            P-VALUE
 TOTAL             329.27        152.        2.1662              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF          MS                  F
 REGRESSION        671.33         13.        51.640             36.938
 ERROR             213.90        153.        1.3980            P-VALUE
 TOTAL             885.23        153.        5.7858              0.000


                             ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR   --------    P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC      0.39810     0.1047       3.803     0.000 0.306      0.3784     0.3981
 LBL       -0.42666E-01 0.1466     -0.2910     0.771-0.025     -0.0272    -0.0427
 LBD       -0.16564E-01 0.5490     -0.3017E-01 0.976-0.003     -0.0027    -0.0166
 LQ        -0.56550E-01 0.9085E-01 -0.6224     0.534-0.053     -0.0560    -0.0565
 LTF        0.62371E-01 0.7317E-01  0.8524     0.394 0.072      0.0745     0.0624
 DPRAF     -0.19954     0.6162     -0.3238     0.746-0.027     -0.0336    -0.1995
 DPRAUS    -0.15496     0.5476     -0.2830     0.777-0.024     -0.0295    -0.1550
 DPREA     -0.39066     0.5472     -0.7140     0.475-0.060     -0.0985    -0.3907
 DPRNA      0.46297E-01 0.5626      0.8229E-01 0.934 0.007      0.0074     0.0463
 DPRNWE     0.94880     0.5012       1.893     0.058 0.158      0.2984     0.9488
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DPRSA    -0.29757E-01 0.5063     -0.5877E-01 0.953-0.005    -0.0072    -0.0298
DPRWAME  -0.87341     0.5220      -1.673     0.094-0.140    -0.1660    -0.8734
CONSTANT  0.55060      1.759      0.3129     0.754 0.026     0.0000     0.5506

DURBIN-WATSON = 1.3468    VON NEUMANN RATIO = 1.3557    RHO =  0.32274
RESIDUAL SUM = -0.11113E-12  RESIDUAL VARIANCE =   1.3980
SUM OF ABSOLUTE ERRORS=   142.96
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3504
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.2577
RUNS TEST:   55 RUNS,   76 POS,    0 ZERO,    77 NEG  NORMAL STATISTIC = -3.6497
COEFFICIENT OF SKEWNESS =  -0.4035 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.0012 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.0793 P-VALUE= 0.130

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
OBSERVED  1.0  0.0  5.0  4.0  3.0  4.0  5.0 18.0 17.0 20.0 20.0  6.0 15.0 21.0  7.0  4.0
2.0  1.0  0.0  0.0

EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
2.8  1.5  0.7  0.5

CHI-SQUARE =   35.7085 WITH  5 DEGREES OF FREEDOM, P-VALUE= 0.000
|_*OLS Main numeric with Dummy-port infrastructure managment and Port region

|_ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpraf dpraus dprea dprna dprnwe
dprsa dprwame/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      65 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3876     R-SQUARE ADJUSTED =   0.3156
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.1909
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.0913
SUM OF SQUARED ERRORS-SSE=   182.20
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -582.942

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.3232
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.39690
 SCHWARZ (1978) CRITERION - LOG SC =             0.73361
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          1.5072
 HANNAN AND QUINN (1979) CRITERION =              1.7052
 RICE (1984) CRITERION =                          1.5311
 SHIBATA (1981) CRITERION =                       1.4555
 SCHWARZ (1978) CRITERION - SC =                  2.0826
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.4872

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF             MS                 F
REGRESSION       115.33         16.         7.2079              6.053
ERROR            182.20        153.         1.1909            P-VALUE
TOTAL            297.53        152.         1.9574              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF             MS                 F
REGRESSION       927.37         17.         54.551             45.808
ERROR            182.20        153.         1.1909            P-VALUE
TOTAL            1109.6        153.         7.2521              0.000
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                                 ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.35358    0.1105       3.199      0.001 0.265     0.3720     0.3536
LCL        0.25081    0.6770E-01   3.704      0.000 0.303     0.2786     0.2508
LCW       -0.11818    0.1131      -1.045      0.296-0.089    -0.0645    -0.1182
LCD       -0.50084    0.3524      -1.421      0.155-0.121    -0.1083    -0.5008
LQ         0.49705E-01 0.7221E-01  0.6883     0.491 0.059     0.0518     0.0497
LTF       -0.12169    0.5162E-01  -2.358      0.018-0.198    -0.1530    -0.1217
DPMPA      -1.0603    0.5314      -1.995      0.046-0.169    -0.3547    -1.0603
DPMPCR     -1.1463    0.6439      -1.780      0.075-0.151    -0.2370    -1.1463
DPMLC     -0.60250    0.5445      -1.106      0.269-0.094    -0.1737    -0.6025
DPRAF     -0.25231    0.6097     -0.4139      0.679-0.035    -0.0447    -0.2523
DPRAUS     0.71222    0.3847       1.851      0.064 0.157     0.1424     0.7122
DPREA     -0.32092    0.3808     -0.8427      0.399-0.072    -0.0851    -0.3209
DPRNA     -0.28068    0.4354     -0.6446      0.519-0.055    -0.0474    -0.2807
DPRNWE    -0.83023E-01 0.3578    -0.2321      0.816-0.020    -0.0275    -0.0830
DPRSA      0.57761    0.3303       1.749      0.080 0.148     0.1480     0.5776
DPRWAME    0.41937    0.3928       1.068      0.286 0.091     0.0839     0.4194
CONSTANT    4.6990     1.861       2.524      0.012 0.212     0.0000     4.6990

DURBIN-WATSON = 1.3880    VON NEUMANN RATIO = 1.3971    RHO =  0.30374
RESIDUAL SUM =  0.30642E-12  RESIDUAL VARIANCE =   1.1909
SUM OF ABSOLUTE ERRORS=   134.31
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3876
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1609
RUNS TEST:   59 RUNS,   83 POS,    0 ZERO,   70 NEG  NORMAL STATISTIC = -2.9329
COEFFICIENT OF SKEWNESS =  -0.3733 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.2419 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    3.7262 P-VALUE= 0.155

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
OBSERVED  1.0  0.0  2.0  6.0  4.0  5.0  9.0 12.0 21.0 10.0 15.0 22.0 21.0 11.0  4.0  6.0
.0  2.0  0.0  0.0

EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
.8  1.5  0.7  0.5

CHI-SQUARE =   20.9529 WITH  1 DEGREES OF FREEDOM, P-VALUE= 0.000

|_ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpraf dpraus dprea dprna dprnwe dprsa
prwame/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      64 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3529     R-SQUARE ADJUSTED =   0.2820
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3926
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1801
SUM OF SQUARED ERRORS-SSE=   213.08
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -534.089

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5383
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.54036
 SCHWARZ (1978) CRITERION - LOG SC =             0.85727
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.7369
 HANNAN AND QUINN (1979) CRITERION =               1.9525
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 RICE (1984) CRITERION =                          1.7610
 SHIBATA (1981) CRITERION =                       1.6839
 SCHWARZ (1978) CRITERION - SC =                  2.3567
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.7166

                    ANALYSIS OF VARIANCE - FROM MEAN
                  SS          DF            MS                 F
REGRESSION      116.19        15.         7.7460              5.562
ERROR           213.08       153.         1.3926             P-VALUE
TOTAL           329.27       152.         2.1662              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                  SS          DF            MS                 F
REGRESSION      672.15        16.         42.009             30.165
ERROR           213.08       153.         1.3926             P-VALUE
TOTAL           885.23       153.         5.7858              0.000


                            ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.40053      0.1068       3.750     0.000 0.305     0.3807     0.4005
LBL      -0.38148E-01 0.1485     -0.2568     0.797-0.022    -0.0243    -0.0381
LBD       0.15287E-01 0.5684      0.2689E-01 0.979 0.002     0.0025     0.0153
LQ       -0.73432E-01 0.9289E-01 -0.7905     0.429-0.067    -0.0728    -0.0734
LTF       0.62328E-01 0.7232E-01  0.8619     0.389 0.073     0.0745     0.0623
DPMPA     0.37325      0.4827      0.7732     0.439 0.066     0.1187     0.3732
DPMPCR    0.53111      0.6188      0.8583     0.391 0.073     0.1044     0.5311
DPMLC     0.41984      0.5021      0.8362     0.403 0.071     0.1150     0.4198
DPRAF    -0.16810      0.6297     -0.2669     0.790-0.023    -0.0283    -0.1681
DPRAUS   -0.19828      0.5627     -0.3524     0.725-0.030    -0.0377    -0.1983
DPREA    -0.38032      0.5404     -0.7037     0.482-0.060    -0.0959    -0.3803
DPRNA     0.76505E-01 0.5741      0.1333     0.894 0.011     0.0123     0.0765
DPRNWE    0.97842      0.5163       1.895     0.058 0.160     0.3077     0.9784
DPRSA     0.18832E-01 0.5182      0.3634E-01 0.971 0.003     0.0046     0.0188
DPRWAME  -0.87833      0.5163      -1.701     0.089-0.144    -0.1669    -0.8783
CONSTANT  0.30259       1.815      0.1667     0.868 0.014     0.0000     0.3026

DURBIN-WATSON = 1.3389    VON NEUMANN RATIO = 1.3477    RHO =  0.32662
RESIDUAL SUM = -0.30753E-13  RESIDUAL VARIANCE =   1.3926
SUM OF ABSOLUTE ERRORS=   143.01
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3529
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.2829
RUNS TEST:    51 RUNS,    74 POS,     0 ZERO,    79 NEG  NORMAL STATISTIC = -4.2903
COEFFICIENT OF SKEWNESS =  -0.4197 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.0098 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.4088 P-VALUE= 0.110

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
OBSERVED  1.0  0.0  7.0  2.0  4.0  2.0  4.0 19.0 18.0 22.0 16.0  7.0 18.0 18.0  8.0  5.0
1.0  1.0  0.0  0.0

EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
2.8  1.5  0.7  0.5

CHI-SQUARE =   47.7271 WITH  2 DEGREES OF FREEDOM, P-VALUE= 0.000
|_*OLS Main numeric with Dummy-port goverance model and Port region

|_ols ltrfc ltrfb lcl lcw lcd lq ltf dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe
dprsa dprwame/ dn hetcov gf loglog

REQUIRED MEMORY IS PAR=      65 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX
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 R-SQUARE =   0.3992     R-SQUARE ADJUSTED =   0.3285
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.1684
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.0809
SUM OF SQUARED ERRORS-SSE=   178.76
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -581.484

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.2982
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.37784
 SCHWARZ (1978) CRITERION - LOG SC =              0.71456
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.4787
 HANNAN AND QUINN (1979) CRITERION =               1.6730
 RICE (1984) CRITERION =                           1.5022
 SHIBATA (1981) CRITERION =                        1.4280
 SCHWARZ (1978) CRITERION - SC =                   2.0433
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.4591

                     ANALYSIS OF VARIANCE - FROM MEAN
                         SS          DF            MS                  F
REGRESSION          118.76          16.         7.4228               6.353
ERROR               178.76         153.         1.1684             P-VALUE
TOTAL               297.53         152.         1.9574               0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                         SS          DF            MS                  F
REGRESSION          930.81          17.         54.754              46.863
ERROR               178.76         153.         1.1684             P-VALUE
TOTAL               1109.6         153.         7.2521               0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO         PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.36887     0.1093      3.376      0.001 0.278     0.3880      0.3689
LCL        0.25773     0.6190E-01  4.163      0.000 0.336     0.2863      0.2577
LCW       -0.60753E-01 0.1105     -0.5499     0.582-0.047    -0.0332     -0.0608
LCD       -0.55520     0.3191     -1.740      0.082-0.148    -0.1201     -0.5552
LQ         0.66147E-01 0.7687E-01  0.8605     0.390 0.074     0.0689      0.0661
LTF       -0.97288E-01 0.5414E-01 -1.797      0.072-0.152    -0.1223     -0.0973
DPGLL     -0.87352     0.3191     -2.737      0.006-0.229    -0.3127     -0.8735
DPGS      -0.29271     0.3847     -0.7608     0.447-0.065    -0.0863     -0.2927
DPGSL     -0.35035     0.2949     -1.188      0.235-0.101    -0.1129     -0.3504
DPRAF     -0.47764     0.5798     -0.8238     0.410-0.070    -0.0847     -0.4776
DPRAUS     0.68689     0.3709      1.852      0.064 0.157     0.1373      0.6869
DPREA     -0.37794     0.3885     -0.9728     0.331-0.083    -0.1002     -0.3779
DPRNA     -0.31511     0.4511     -0.6985     0.485-0.060    -0.0532     -0.3151
DPRNWE    -0.80177E-01 0.3464     -0.2314     0.817-0.020    -0.0265     -0.0802
DPRSA      0.39281     0.3456      1.137      0.256 0.097     0.1007      0.3928
DPRWAME    0.23197     0.3941      0.5886     0.556 0.050     0.0464      0.2320
CONSTANT   3.2243      1.742       1.851      0.064 0.157     0.0000      3.2243

DURBIN-WATSON = 1.4336    VON NEUMANN RATIO = 1.4430    RHO =  0.28003
RESIDUAL SUM =  0.11813E-12  RESIDUAL VARIANCE =   1.1684
SUM OF ABSOLUTE ERRORS=   130.95
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3992
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.1732
RUNS TEST:   67 RUNS,   81 POS,     0 ZERO,    72 NEG  NORMAL STATISTIC = -1.6662
COEFFICIENT OF SKEWNESS =  -0.3791 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =    0.4749 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.7212 P-VALUE= 0.094

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
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```
 OBSERVED  2.0  0.0  1.0  5.0  3.0  7.0  6.0 16.0 19.0 13.0 14.0 29.0 11.0 11.0  6.0  4.0
5.0  1.0  0.0  0.0

 EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
2.8  1.5  0.7  0.5

 CHI-SQUARE =   26.0641 WITH  1 DEGREES OF FREEDOM, P-VALUE= 0.000

 |_ols ltrfb ltrfc lbl lbd lq ltf dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa
dprwame/ dn hetcov gf loglog

 REQUIRED MEMORY IS PAR=      64 CURRENT PAR=  112400
  OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3690     R-SQUARE ADJUSTED =   0.2999
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3580
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1653
 SUM OF SQUARED ERRORS-SSE=   207.78
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -532.162

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5000
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.51518
  SCHWARZ (1978) CRITERION - LOG SC =             0.83208
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =          1.6937
  HANNAN AND QUINN (1979) CRITERION =              1.9039
  RICE (1984) CRITERION =                          1.7172
  SHIBATA (1981) CRITERION =                       1.6420
  SCHWARZ (1978) CRITERION - SC =                  2.2981
  AKAIKE (1974) INFORMATION CRITERION - AIC =      1.6739

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS         DF            MS                 F
 REGRESSION        121.49        15.         8.0993             5.964
 ERROR             207.78       153.         1.3580           P-VALUE
 TOTAL             329.27       152.         2.1662             0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS         DF            MS                 F
 REGRESSION        677.45        16.         42.341            31.178
 ERROR             207.78       153.         1.3580           P-VALUE
 TOTAL             885.23       153.         5.7858             0.000


                             ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME     COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC      0.41536    0.1000      4.152       0.000 0.334     0.3948     0.4154
 LBL       -0.64282E-01 0.1326    -0.4849      0.628-0.041    -0.0409    -0.0643
 LBD       -0.85233E-01 0.5427    -0.1570      0.875-0.013    -0.0140    -0.0852
 LQ        -0.69160E-01 0.8623E-01 -0.8021     0.423-0.068    -0.0685    -0.0692
 LTF        0.43400E-01 0.7601E-01  0.5710     0.568 0.049     0.0519     0.0434
 DPGLL      0.13351    0.3014      0.4430      0.658 0.038     0.0454     0.1335
 DPGS      -0.44364    0.3995     -1.110       0.267-0.094    -0.1244    -0.4436
 DPGSL     -0.96757E-01 0.3041    -0.3181      0.750-0.027    -0.0296    -0.0968
 DPRAF     -0.86095E-01 0.6109    -0.1409      0.888-0.012    -0.0145    -0.0861
 DPRAUS     0.16159E-01 0.5585     0.2893E-01 0.977 0.002     0.0031     0.0162
 DPREA     -0.32073    0.5660     -0.5667      0.571-0.048    -0.0808    -0.3207
 DPRNA      0.37922E-01 0.6083     0.6234E-01 0.950 0.005     0.0061     0.0379
 DPRNWE     0.97985    0.5086      1.927       0.054 0.162     0.3081     0.9799
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DPRSA     0.53201E-02 0.5139      0.1035E-01 0.992 0.001     0.0013     0.0053
DPRWAME  -0.68629     0.5365      -1.279     0.201-0.109    -0.1304    -0.6863
CONSTANT  1.5510      1.941       0.7991     0.424 0.068     0.0000     1.5510

DURBIN-WATSON = 1.3078    VON NEUMANN RATIO = 1.3164    RHO =  0.34120
RESIDUAL SUM = -0.22204E-12  RESIDUAL VARIANCE =   1.3580
SUM OF ABSOLUTE ERRORS=   141.74
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3690
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.3046
RUNS TEST:   49 RUNS,   75 POS,     0 ZERO,    78 NEG  NORMAL STATISTIC = -4.6204
COEFFICIENT OF SKEWNESS =  -0.4018 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0178 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.0569 P-VALUE= 0.132

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
OBSERVED  1.0  2.0  3.0  3.0  4.0  5.0  5.0 16.0 15.0 24.0 18.0  8.0 13.0 22.0  8.0  4.0
.0  0.0  1.0  0.0

EXPECTED  0.5  0.7  1.5  2.8  4.7  7.4 10.6 13.8 16.5 18.0 18.0 16.5 13.8 10.6  7.4  4.7
.8  1.5  0.7  0.5

CHI-SQUARE =   30.7531 WITH  2 DEGREES OF FREEDOM, P-VALUE= 0.000
|_*OLS Main numerical variables with All Dummies

|_ols ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
prea dprna dprnwe dprsa dprwame/ dn hetcov
|  gf loglog predict=E1

REQUIRED MEMORY IS PAR=      71 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.4208     R-SQUARE ADJUSTED =   0.3381
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.1263
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.0613
SUM OF SQUARED ERRORS-SSE=   172.32
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -578.676

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.2735
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.38036
 SCHWARZ (1978) CRITERION - LOG SC =              0.77649
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.4905
 HANNAN AND QUINN (1979) CRITERION =               1.7182
 RICE (1984) CRITERION =                           1.5250
 SHIBATA (1981) CRITERION =                        1.4207
 SCHWARZ (1978) CRITERION - SC =                   2.1738
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.4628

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS           DF           MS                 F
REGRESSION        125.21          19.        6.5898             5.851
ERROR             172.32         153.        1.1263           P-VALUE
TOTAL             297.53         152.        1.9574             0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS           DF           MS                 F
REGRESSION        937.25          20.        46.863            41.608
ERROR             172.32         153.        1.1263           P-VALUE
TOTAL             1109.6         153.        7.2521             0.000
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                                   ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.36590     0.1098       3.332     0.001 0.278     0.3849     0.3659
LCL        0.26034     0.6330E-01   4.113     0.000 0.336     0.2892     0.2603
LCW       -0.12037     0.1069      -1.126     0.260-0.097    -0.0657    -0.1204
LCD       -0.49740     0.3383      -1.470     0.141-0.126    -0.1076    -0.4974
LQ         0.70452E-01 0.7044E-01   1.000     0.317 0.086     0.0734     0.0705
LTF       -0.10562     0.5214E-01  -2.026     0.043-0.173    -0.1328    -0.1056
DPMPA      -1.0538     0.5351      -1.969     0.049-0.168    -0.3526    -1.0538
DPMPCR     -1.0630     0.6405      -1.660     0.097-0.142    -0.2198    -1.0630
DPMLC     -0.58491     0.5148      -1.136     0.256-0.098    -0.1686    -0.5849
DPGLL     -0.39874     0.3198      -1.247     0.212-0.107    -0.1427    -0.3987
DPGS       0.18237     0.3660      0.4983     0.618 0.043     0.0538     0.1824
DPGSL      0.14463     0.3199      0.4522     0.651 0.039     0.0466     0.1446
DPRAF     -0.42521     0.5876     -0.7237     0.469-0.063    -0.0754    -0.4252
DPRAUS     0.57601     0.3674       1.568     0.117 0.135     0.1152     0.5760
DPREA     -0.35695     0.3785     -0.9431     0.346-0.082    -0.0946    -0.3569
DPRNA     -0.19964     0.4476     -0.4460     0.656-0.039    -0.0337    -0.1996
DPRNWE    -0.14589     0.3583     -0.4072     0.684-0.035    -0.0483    -0.1459
DPRSA      0.38344     0.3409       1.125     0.261 0.097     0.0983     0.3834
DPRWAME    0.24791     0.4022      0.6164     0.538 0.053     0.0496     0.2479
CONSTANT    4.0191      1.769       2.271     0.023 0.193     0.0000     4.0191

DURBIN-WATSON = 1.4702    VON NEUMANN RATIO = 1.4798    RHO =  0.26139
RESIDUAL SUM =  0.33662E-12  RESIDUAL VARIANCE =   1.1263
SUM OF ABSOLUTE ERRORS=   127.69
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4208
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.2014
RUNS TEST:   67 RUNS,   83 POS,     0 ZERO,    70 NEG  NORMAL STATISTIC = -1.6256
COEFFICIENT OF SKEWNESS =  -0.4168 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.5589 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    5.9484 P-VALUE= 0.051

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  2.0  0.0  0.0  0.0  2.0  2.0  5.0  3.0  5.0  3.0  8.0  8.0 14.0  9.0  9.0 13.0
.7.0 14.0  7.0  8.0
          7.0  6.0  4.0  1.0  2.0  4.0  0.0  0.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
.1.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   27.7181 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.001
|_GENR E1=EXP(E1+$SIG2/2)
...NOTE..CURRENT VALUE OF $SIG2=   1.1263
|_print ltrfc E01 E1
      LTRFC           E01            E1
   2.484907       18.19743       38.44206
  0.6931472       16.81529       17.51413
  0.7371641       7.616830       6.838787
   2.929058       15.36098       19.46245
   3.154870       16.00878       15.45147
   3.154870       13.01614       7.393900
   3.154870       7.211295       8.321799
   3.154870       11.23307       10.21833
   2.197225       12.86218       10.37032
  -3.912023       19.29802       1.578888
   2.017566       18.67193       20.94908
   3.446489       25.79058       16.36139
   2.200552       29.29607       32.53998
   2.506342       27.52544       29.22834
   2.232163       21.65924       45.54526
   2.232163       19.32493       18.28560
   3.091042       12.53965       18.16964
   4.352083       38.22243       52.37512
   4.215086       37.83520       92.40169
```

2.873565	42.30059	80.07751
3.841171	39.45609	63.26866
3.352357	43.42955	54.60604
3.978747	36.42831	75.62773
2.282382	29.13573	12.68085
0.4637340	27.75973	25.10429
2.219203	12.16137	9.989070
2.230014	13.30138	26.72892
0.7608058	5.879504	6.231953
0.7608058	21.38305	14.02812
0.7227060	7.255774	9.286343
0.7608058	6.719198	10.01027
0.7608058	11.21306	6.457669
2.079442	7.125908	9.921030
2.799109	12.55845	7.457179
2.799109	7.706162	9.609831
1.747459	8.255276	5.412413
-1.660731	17.75426	6.893659
-1.660731	13.92866	3.350224
-1.660731	3.286347	1.455084
1.214913	4.883518	2.970214
3.336125	12.30582	5.172076
2.451005	9.975354	4.554726
2.451005	7.642932	6.525159
3.218876	15.37596	39.58021
3.218876	23.52743	38.85854
4.262680	33.95517	34.11053
4.262680	25.71674	18.39414
3.433987	26.55320	31.20609
2.639057	17.32667	26.86922
2.866193	22.20407	77.49781
3.688879	22.80284	55.15338
2.509599	12.77691	19.53829
1.615420	5.505532	11.98456
3.185939	2.741852	5.041123
0.1043600	-2.286507	3.576087
2.954910	13.50326	9.041643
1.635106	6.344785	3.617364
0.9950331E-02	-0.8674561	3.539915
2.897568	13.00765	19.45336
2.551006	40.34980	114.7569
1.857859	23.49060	29.22089
4.522006	15.13654	18.03302
0.4446858	8.632281	4.361899
1.348073	11.17661	4.826211
0.7793249	9.653795	3.302874
1.638997	14.30674	10.83614
0.5988365	12.44544	7.709471
0.7323679	10.40830	4.702304
2.558002	27.63300	24.34995
0.7323679	14.25730	8.356365
2.685805	32.96929	55.95107
3.538057	13.60249	15.00904
1.766442	32.13832	30.74325
1.736951	19.67141	7.627597
0.6418539	13.27248	6.678630
3.009635	19.74359	31.99067
2.343727	23.22002	28.83136
4.163871	24.62922	15.53601
3.811982	10.69783	32.01873
1.205971	14.56182	16.46660
2.837908	26.86388	19.65687
2.829087	25.12253	20.55036
3.054473	22.78740	39.50677
3.454738	15.41751	5.979397
0.1043600	6.724621	12.19658
0.1043600	14.50815	12.16442
0.1043600	14.12208	9.662978
0.1043600	6.724621	12.19658
0.1043600	14.50815	12.16442
0.1043600	14.12208	9.662978

1.488400	15.99235	23.14750
0.1043600	9.517477	7.619720
0.1043600	9.181726	12.26364
0.1043600	12.84691	13.26934
0.1043600	13.23586	10.71155
0.1043600	21.39496	14.36583
2.359910	47.33628	24.49067
3.738384	24.13825	37.30752
4.204095	56.03152	100.3632
2.912894	40.74942	20.74299
4.410978	21.81279	27.82340
2.493205	22.26742	16.90654
4.034595	39.49204	38.20162
4.436633	42.73018	56.96098
3.886705	33.63920	59.96115
3.628333	37.86110	53.49900
3.912023	20.16070	31.53176
3.640214	24.14113	39.10111
3.829076	16.74069	24.47146
2.750471	23.09946	21.74996
1.581038	16.78619	7.460018
1.403643	6.681871	3.964479
1.989243	11.31196	17.80716
1.989243	18.50343	7.732783
2.374906	-0.7114859	4.126425
2.681706	20.78690	14.61109
1.631199	11.78139	10.81424
2.057963	17.42837	17.36866
2.607124	15.45177	14.65995
2.219203	20.06751	13.26495
3.182212	26.20727	66.54567
2.371178	24.83722	30.76796
2.322388	29.76448	30.56795
2.682390	14.65121	18.06702
3.527536	20.59000	32.40964
2.484907	19.38121	28.76052
3.577948	22.59782	39.08728
3.002708	20.27907	18.49996
3.270709	17.23472	14.85068
2.660260	23.47127	43.35045
3.186353	20.35641	18.45375
3.018960	17.63348	21.51417
3.540959	44.43943	236.0180
4.025352	37.14394	89.09093
3.401197	25.31798	68.04740
3.258097	22.50924	36.82758
1.515127	19.26827	23.88765
1.470176	17.32009	17.34522
3.182212	30.62250	33.21604
3.018960	26.41841	35.83333
3.970292	25.45793	28.36352
3.952781	35.87350	83.26038
2.831447	27.55453	51.41271
3.044522	8.919256	9.776248
3.044522	18.12423	18.10859
3.091042	18.39959	14.37752
1.386294	19.31869	16.19117
1.663926	20.27278	17.70722
1.193922	18.41758	5.152143
1.156881	9.814344	6.105304
2.587764	18.20819	25.82698
1.223775	26.39545	34.92370
3.988984	20.92173	28.69015
1.660131	12.40198	13.81915
4.255613	23.37650	53.65265
1.340250	15.46969	25.52580
4.255613	23.37650	53.65265
1.340250	15.46969	25.52580

|_ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea

```
dprna dprnwe dprsa dprwame/ dn hetcov gf
 | loglog predict=E2

 REQUIRED MEMORY IS PAR=      71 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3707     R-SQUARE ADJUSTED =   0.2862
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3543
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1637
 SUM OF SQUARED ERRORS-SSE=   207.20
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -531.951

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5224
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.55163
  SCHWARZ (1978) CRITERION - LOG SC =             0.92795
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =          1.7655
  HANNAN AND QUINN (1979) CRITERION =              2.0228
  RICE (1984) CRITERION =                          1.8018
  SHIBATA (1981) CRITERION =                       1.6906
  SCHWARZ (1978) CRITERION - SC =                  2.5293
  AKAIKE (1974) INFORMATION CRITERION - AIC =      1.7361

                    ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                F
 REGRESSION        122.06         18.         6.7813             5.007
 ERROR             207.20        153.         1.3543           P-VALUE
 TOTAL             329.27        152.         2.1662             0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                F
 REGRESSION        678.02         19.         35.685            26.350
 ERROR             207.20        153.         1.3543           P-VALUE
 TOTAL             885.23        153.         5.7858             0.000


                            ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO         PARTIAL STANDARDIZED ELASTICITY
  NAME     COEFFICIENT   ERROR    --------     P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC      0.41910    0.1015       4.130       0.000 0.336     0.3984     0.4191
 LBL       -0.55987E-01 0.1334     -0.4198      0.675-0.036    -0.0356    -0.0560
 LBD       -0.57510E-01 0.5484     -0.1049      0.916-0.009    -0.0094    -0.0575
 LQ        -0.84293E-01 0.8835E-01 -0.9541      0.340-0.082    -0.0835    -0.0843
 LTF        0.45829E-01 0.7492E-01  0.6117      0.541 0.053     0.0548     0.0458
 DPMPA      0.43180    0.4644       0.9298      0.352 0.080     0.1373     0.4318
 DPMPCR     0.45091    0.6027       0.7481      0.454 0.064     0.0886     0.4509
 DPMLC      0.41291    0.4604       0.8969      0.370 0.077     0.1131     0.4129
 DPGLL      0.18579E-01 0.3267      0.5687E-01 0.955 0.005     0.0063     0.0186
 DPGS      -0.55033    0.4416      -1.246       0.213-0.107    -0.1543    -0.5503
 DPGSL     -0.22047    0.3357      -0.6567      0.511-0.057    -0.0676    -0.2205
 DPRAF     -0.78970E-01 0.6311     -0.1251      0.900-0.011    -0.0133    -0.0790
 DPRAUS     0.11551E-02 0.5707      0.2024E-02 0.998 0.000     0.0002     0.0012
 DPREA     -0.30343    0.5580      -0.5438      0.587-0.047    -0.0765    -0.3034
 DPRNA      0.32293E-01 0.6239      0.5176E-01 0.959 0.004     0.0052     0.0323
 DPRNWE     0.99201    0.5240       1.893       0.058 0.161     0.3120     0.9920
 DPRSA      0.25459E-01 0.5360      0.4749E-01 0.962 0.004     0.0062     0.0255
 DPRWAME   -0.69380    0.5309      -1.307       0.191-0.112    -0.1319    -0.6938
 CONSTANT    1.2761     1.945       0.6560      0.512 0.057     0.0000     1.2761

 DURBIN-WATSON = 1.3017    VON NEUMANN RATIO = 1.3102    RHO =  0.34416
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 RESIDUAL SUM = -0.25713E-12  RESIDUAL VARIANCE =   1.3543
 SUM OF ABSOLUTE ERRORS=   141.88
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3707
 R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.3204
 RUNS TEST:   49 RUNS,   75 POS,    0 ZERO,   78 NEG  NORMAL STATISTIC = -4.6204
 COEFFICIENT OF SKEWNESS =  -0.4179 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =  -0.0006 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.3765 P-VALUE= 0.112

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  0.0  1.0  2.0  3.0  1.0  2.0  3.0  3.0  3.0  3.0  7.0 11.0  9.0 14.0 16.0 14.0
3.0 10.0  5.0 17.0
          13.0  5.0  3.0  3.0  0.0  1.0  0.0  1.0  0.0  0.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   45.6522 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_GENR E2=EXP(E2+$SIG2/2)
 ...NOTE..CURRENT VALUE OF $SIG2=   1.3543
 |_print ltrfb E02 E2
       LTRFB            E02             E2
     2.302585       1.949940       4.716514
     1.791759      0.7669502       3.591442
     1.249902       10.92479       5.854273
     1.701105       12.29733       12.30024
     1.553925     -0.9712274       11.22096
     1.553925       10.81268       14.50141
     1.553925       14.84356       12.33708
     1.553925       11.38413       11.17797
     3.401197       12.25688       11.32949
    -4.605170     -0.3650335      0.4848105
     1.430311       7.851499       12.33274
   -0.9431068E-01   12.22099       15.06521
     2.929058       2.739058       11.34179
     2.780681       8.450520       18.22981
     3.050220       12.21039       13.98185
     2.819592       12.81476       16.64016
    0.6626880       7.758829       18.91428
     1.826161       20.14303       16.25800
     2.296567       17.95664       15.63260
     1.974081     -0.9810760       10.44275
     2.232163       9.211575       16.28149
     2.271094       3.699407       11.09901
     1.809927       14.15438       15.87157
   -0.7133499       6.694272       7.713737
     1.570697       5.804784       3.449802
     2.501436      0.3567676       8.285410
     2.839078       10.65792       9.534111
     2.075684       18.37451       5.001845
     1.078410      -7.124653       2.992493
     2.270062       14.48877       4.955069
     2.075684      0.1106974       4.716101
     2.075684       2.086993       4.982022
     1.360977       11.02479       7.860838
     1.472472      -1.264361       5.385660
     1.472472       15.91187       11.87120
    0.1988509      -6.068985       5.619198
    -1.171183      -16.20146       1.119277
    -1.171183      -1.754162      0.9507796
    -1.171183       6.285817       1.592806
   -0.8675006       11.07013       5.483900
   -0.6733446       9.720487       15.06253
    -1.171183       9.679569       10.52370
    -1.171183       11.04011       9.908834
     2.708050       10.41000       9.971262
     3.135494       6.880221       8.828669
     3.135494       35.80329       14.92410
```

3.178054	35.22894	16.52224
3.135494	6.233693	11.80293
2.708050	11.18283	8.126068
3.912023	21.52194	16.89655
2.302585	19.48560	18.36271
1.252763	14.95571	11.99851
1.827770	13.71944	10.08573
-0.1278334	21.18622	18.61092
0.6418539	16.25459	4.749868
0.0000000E+00	19.34860	16.02325
-1.272966	17.70789	9.415026
0.3646431	16.95412	4.592302
2.034706	13.25455	9.348820
3.937301	16.45758	13.88925
4.255755	17.63092	8.347857
1.545433	31.30218	32.46422
1.264127	6.195955	6.695839
0.8712934	2.558131	9.558017
1.539015	5.448536	9.478278
1.085189	10.15663	13.05004
1.302913	5.626121	6.641279
1.348073	11.13322	9.474771
3.910822	2.850382	8.782146
1.587192	5.328847	5.910894
4.074142	27.38838	37.93792
3.538057	31.44035	56.19732
2.686486	18.06614	24.94560
1.824549	12.95328	21.64566
-0.8915981	17.54147	11.24185
3.085573	33.69727	40.87024
1.771557	34.66470	31.95616
3.470723	45.31519	76.15163
3.007661	30.06341	53.79619
2.096790	18.80214	19.94620
1.153732	22.33914	32.87159
0.9631743	17.46927	33.10197
2.484907	23.71070	25.46319
0.6151856	31.26986	27.69828
3.349202	27.62031	12.04278
3.349202	28.65939	16.00455
3.349202	29.06120	15.95638
3.388450	25.41466	21.27610
3.388450	29.52370	14.35226
3.388450	27.37448	14.45139
3.291754	29.69788	16.08967
3.221273	29.85273	17.11324
3.125883	21.49105	9.852816
4.870837	35.32411	35.93862
2.855895	38.02800	59.42902
4.574299	39.88790	55.99343
4.903644	40.82375	69.21531
2.604909	51.28566	87.63357
3.186353	30.73979	42.39517
2.421257	24.43319	54.27229
4.675163	53.85936	76.78409
4.193134	42.87812	65.13366
4.544571	62.89029	63.32860
4.268718	38.94271	58.11533
4.125520	31.48550	61.15923
3.575431	35.74188	66.36331
2.241773	49.29031	53.66031
1.989243	19.13394	21.50021
1.671473	24.83370	27.03856
1.851599	24.66791	29.51326
1.913977	19.22825	24.63166
2.084429	29.20765	44.48814
1.913977	19.22825	24.63166
2.084429	29.20765	44.48814
1.175573	20.66338	29.27922
2.893700	19.17439	16.33585

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    2.304583        24.16836        30.74386
    1.181727        25.24631        34.15323
    1.699279        24.57882        36.03119
    3.218876        8.756056        17.23712
    1.490654        7.687783        10.24903
    1.960095        9.595564        16.76913
    1.808289        14.11049        15.41414
    1.726332        14.42398        16.85659
    1.386294        13.42511        15.11757
    2.208274        16.92676        18.90778
    1.247032        11.16880        14.47070
    1.490654        13.51287        18.01308
    2.833213        9.195271        11.84077
    1.047319        11.86293        14.49797
    1.244155        13.69856        12.66279
    3.540959        8.348224        15.68283
    3.610918        23.86842        29.64053
    2.079442        12.04798        15.80240
    1.386294        9.600589        13.40657
   0.9707789        4.942872        6.452078
    2.461297       -4.223637        8.806390
    1.098612       -1.579705        12.49205
    1.241269        5.370528        15.49797
    2.639057        28.85110        30.86521
    2.931194        8.888182        16.42846
    2.777576        5.271270        11.98918
   0.0000000E+00    11.38028        7.976678
   0.0000000E+00    2.952492        4.704677
   0.0000000E+00   -3.686267        4.642830
   0.0000000E+00   -6.608081        2.225351
   0.6830968       0.1829535        3.396820
   0.4700036        5.295817        4.197146
  -0.4082199E-01    8.346084        5.062435
    3.280911        4.558011        7.373509
   0.9360934        3.063949        3.580543
    2.302585        12.51412        7.795476
    1.255616       -2.909550        3.608098
    1.467874        16.82038        7.078711
   0.8501509        5.969815        3.325444
|_***Estimating effect of dummy dpmpa on ltrfc
|_* Estimation

|_OLS ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
dprea dprna dprnwe dprsa dprwame / dn hetco
| v loglog COEF=BETA STDE&
| RR=SE

REQUIRED MEMORY IS PAR=       72 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.4208     R-SQUARE ADJUSTED =   0.3381
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.1263
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.0613
SUM OF SQUARED ERRORS-SSE=   172.32
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -578.676

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.2735
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.38036
 SCHWARZ (1978) CRITERION - LOG SC =              0.77649
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
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   GENERALIZED CROSS VALIDATION - GCV =            1.4905
 HANNAN AND QUINN (1979) CRITERION =               1.7182
 RICE (1984) CRITERION =                           1.5250
 SHIBATA (1981) CRITERION =                        1.4207
 SCHWARZ (1978) CRITERION - SC =                   2.1738
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.4628

                    ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF          MS                  F
REGRESSION         125.21         19.       6.5898              5.851
ERROR              172.32        153.       1.1263            P-VALUE
TOTAL              297.53        152.       1.9574              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF          MS                  F
REGRESSION         937.25         20.       46.863             41.608
ERROR              172.32        153.       1.1263            P-VALUE
TOTAL              1109.6        153.       7.2521              0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO       PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.36590     0.1098       3.332     0.001 0.278     0.3849     0.3659
LCL        0.26034     0.6330E-01   4.113     0.000 0.336     0.2892     0.2603
LCW       -0.12037     0.1069      -1.126     0.260-0.097    -0.0657    -0.1204
LCD       -0.49740     0.3383      -1.470     0.141-0.126    -0.1076    -0.4974
LQ         0.70452E-01 0.7044E-01   1.000     0.317 0.086     0.0734     0.0705
LTF       -0.10562     0.5214E-01  -2.026     0.043-0.173    -0.1328    -0.1056
DPMPA      -1.0538     0.5351      -1.969     0.049-0.168    -0.3526    -1.0538
DPMPCR     -1.0630     0.6405      -1.660     0.097-0.142    -0.2198    -1.0630
DPMLC     -0.58491     0.5148      -1.136     0.256-0.098    -0.1686    -0.5849
DPGLL     -0.39874     0.3198      -1.247     0.212-0.107    -0.1427    -0.3987
DPGS       0.18237     0.3660       0.4983    0.618 0.043     0.0538     0.1824
DPGSL      0.14463     0.3199       0.4522    0.651 0.039     0.0466     0.1446
DPRAF     -0.42521     0.5876      -0.7237    0.469-0.063    -0.0754    -0.4252
DPRAUS     0.57601     0.3674       1.568     0.117 0.135     0.1152     0.5760
DPREA     -0.35695     0.3785      -0.9431    0.346-0.082    -0.0946    -0.3569
DPRNA     -0.19964     0.4476      -0.4460    0.656-0.039    -0.0337    -0.1996
DPRNWE    -0.14589     0.3583      -0.4072    0.684-0.035    -0.0483    -0.1459
DPRSA      0.38344     0.3409       1.125     0.261 0.097     0.0983     0.3834
DPRWAME    0.24791     0.4022       0.6164    0.538 0.053     0.0496     0.2479
CONSTANT   4.0191       1.769       2.271     0.023 0.193     0.0000     4.0191

DURBIN-WATSON = 1.4702    VON NEUMANN RATIO = 1.4798    RHO =  0.26139
RESIDUAL SUM =  0.33662E-12  RESIDUAL VARIANCE =   1.1263
SUM OF ABSOLUTE ERRORS=   127.69
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4208
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.2014
RUNS TEST:    67 RUNS,    83 POS,     0 ZERO,    70 NEG  NORMAL STATISTIC = -1.6256
COEFFICIENT OF SKEWNESS =  -0.4168 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.5589 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    5.9484 P-VALUE= 0.051

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  2.0  0.0  0.0  0.0  2.0  2.0  5.0  3.0  5.0  3.0  8.0  8.0 14.0  9.0  9.0 13.0
17.0 14.0  7.0  8.0
           7.0  6.0  4.0  1.0  2.0  4.0  0.0  0.0  0.0  0.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   27.7181 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.001
 |_* Estimate the percentage effect of dummy variable dpmpa on ltrfc
 |_GEN1 C1=BETA:7
 |_GEN1 SE1=SE:7
 |_GEN1 G1= 100*(EXP(C1-SE1*SE1/2)-1)
 |_* Estimate the percentage effect of dummy variable dpmpcr on ltrfc
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 |_GEN1 C2=BETA:8
 |_GEN1 SE2=SE:8
 |_GEN1 G2= 100*(EXP(C2-SE2*SE2/2)-1)

 |_ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame/ dn hetcov gf
 | loglog COEF=BETA STDERR&
 | =SE

 REQUIRED MEMORY IS PAR=      71 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3707     R-SQUARE ADJUSTED =   0.2862
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3543
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1637
 SUM OF SQUARED ERRORS-SSE=   207.20
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION(IF DEPVAR LOG) = -531.951

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5224
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.55163
  SCHWARZ (1978) CRITERION - LOG SC =             0.92795
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =          1.7655
  HANNAN AND QUINN (1979) CRITERION =              2.0228
  RICE (1984) CRITERION =                          1.8018
  SHIBATA (1981) CRITERION =                       1.6906
  SCHWARZ (1978) CRITERION - SC =                  2.5293
  AKAIKE (1974) INFORMATION CRITERION - AIC =      1.7361

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF             MS                 F
 REGRESSION        122.06         18.         6.7813              5.007
 ERROR             207.20        153.         1.3543            P-VALUE
 TOTAL             329.27        152.         2.1662              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF             MS                 F
 REGRESSION        678.02         19.         35.685             26.350
 ERROR             207.20        153.         1.3543            P-VALUE
 TOTAL             885.23        153.         5.7858              0.000


                             ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC      0.41910     0.1015      4.130      0.000 0.336     0.3984     0.4191
 LBL       -0.55987E-01 0.1334     -0.4198     0.675-0.036    -0.0356    -0.0560
 LBD       -0.57510E-01 0.5484     -0.1049     0.916-0.009    -0.0094    -0.0575
 LQ        -0.84293E-01 0.8835E-01 -0.9541     0.340-0.082    -0.0835    -0.0843
 LTF        0.45829E-01 0.7492E-01  0.6117     0.541 0.053     0.0548     0.0458
 DPMPA      0.43180     0.4644      0.9298     0.352 0.080     0.1373     0.4318
 DPMPCR     0.45091     0.6027      0.7481     0.454 0.064     0.0886     0.4509
 DPMLC      0.41291     0.4604      0.8969     0.370 0.077     0.1131     0.4129
 DPGLL      0.18579E-01 0.3267      0.5687E-01 0.955 0.005     0.0063     0.0186
 DPGS      -0.55033     0.4416     -1.246      0.213-0.107    -0.1543    -0.5503
 DPGSL     -0.22047     0.3357     -0.6567     0.511-0.057    -0.0676    -0.2205
 DPRAF     -0.78970E-01 0.6311     -0.1251     0.900-0.011    -0.0133    -0.0790
 DPRAUS     0.11551E-02 0.5707      0.2024E-02 0.998 0.000     0.0002     0.0012
 DPREA     -0.30343     0.5580     -0.5438     0.587-0.047    -0.0765    -0.3034
 DPRNA      0.32293E-01 0.6239      0.5176E-01 0.959 0.004     0.0052     0.0323
```

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DPRNWE    0.99201     0.5240       1.893      0.058 0.161     0.3120      0.9920
DPRSA     0.25459E-01 0.5360      0.4749E-01 0.962 0.004     0.0062      0.0255
DPRWAME  -0.69380     0.5309      -1.307      0.191-0.112    -0.1319     -0.6938
CONSTANT   1.2761      1.945      0.6560      0.512 0.057     0.0000      1.2761

DURBIN-WATSON = 1.3017    VON NEUMANN RATIO = 1.3102    RHO =  0.34416
RESIDUAL SUM = -0.25713E-12  RESIDUAL VARIANCE =   1.3543
SUM OF ABSOLUTE ERRORS=   141.88
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3707
R-SQUARE BETWEEN ANTILOGS OBSERVED AND PREDICTED = 0.3204
RUNS TEST:   49 RUNS,   75 POS,    0 ZERO,   78 NEG  NORMAL STATISTIC = -4.6204
COEFFICIENT OF SKEWNESS =  -0.4179 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0006 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.3765 P-VALUE= 0.112

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  0.0  1.0  2.0  3.0  1.0  2.0  3.0  3.0  3.0  3.0  7.0 11.0  9.0 14.0 16.0 14.0
3.0 10.0  5.0 17.0
         13.0  5.0  3.0  3.0  0.0  1.0  0.0  1.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   45.6522 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
|_* Estimate the percentage effect of dummy variable dprnwe on ltrfb
|_GEN1 C3=BETA:16
|_GEN1 SE3=SE:16
|_GEN1 G3= 100*(EXP(C3-SE3*SE3/2)-1)
|_**% change in channel/port dues for dummay varaible port authority
|_PRINT G1
G1
  -69.78965
|_**% change in channel/port dues for dummay varaible cport corporation
|_PRINT G2
G2
  -71.86433
|_**% cahnge in berth occupancy charge for dummay varaible port region north and west
Europe
|_PRINT G3
G3
   135.0683
|_end
|_*Simultaneous Equation 2stage least square

|_2sls ltrfc ltrfb (lcl lcw lcd lq ltf)/ dn gf rstat
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
  5 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.1401     R-SQUARE ADJUSTED =   0.1344
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6723
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2932
SUM OF SQUARED ERRORS-SSE=   255.85
MEAN OF DEPENDENT VARIABLE =   2.3038


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.25244     0.3533      0.7146     0.475 0.058     0.2656      0.2089
CONSTANT   1.8226     0.6815       2.674     0.007 0.213     0.0000      0.7911

DURBIN-WATSON = 1.0987    VON NEUMANN RATIO = 1.1060    RHO =  0.45052
RESIDUAL SUM =  0.16209E-12  RESIDUAL VARIANCE =   1.6723
SUM OF ABSOLUTE ERRORS=   159.30
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
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RUNS TEST:   44 RUNS,   83 POS,    0 ZERO,   70 NEG  NORMAL STATISTIC = -5.3841
COEFFICIENT OF SKEWNESS =  -0.7925 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.3704 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   16.3531 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  3.0  8.0  2.0 13.0  8.0 24.0 20.0 21.0 34.0 14.0  5.0  0.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   39.5092 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.000

|_2sls ltrfb ltrfc (lbl lbd lq ltf)/ dn gf rstat
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
  4 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.1360     R-SQUARE ADJUSTED =   0.1303
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.8594
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3636
SUM OF SQUARED ERRORS-SSE=   284.49
MEAN OF DEPENDENT VARIABLE =   1.9062


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.26389     0.3921      0.6730     0.501 0.055      0.2508     0.3189
CONSTANT   1.2983     0.9100       1.427     0.154 0.115      0.0000     0.6811

DURBIN-WATSON = 1.0380    VON NEUMANN RATIO = 1.0448    RHO =  0.48076
RESIDUAL SUM = -0.13800E-12  RESIDUAL VARIANCE =   1.8594
SUM OF ABSOLUTE ERRORS=   162.34
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
RUNS TEST:   46 RUNS,   78 POS,    0 ZERO,   75 NEG  NORMAL STATISTIC = -5.1073
COEFFICIENT OF SKEWNESS =  -0.3874 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.3892 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.4798 P-VALUE= 0.106

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  3.0  3.0 10.0  5.0 13.0 26.0 29.0 21.0 19.0  7.0 13.0  3.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   19.9898 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.045
|_*with dummy variables

|_2sls ltrfc ltrfb lcl lcw lcd lq ltf ( lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs
dpgsl dpraf dpraus dprea dprna dprnwe dp
| rsa dprwame)/ dn rstat &
| gf
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
 18 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.2782     R-SQUARE ADJUSTED =   0.2485
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.4036
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1847
SUM OF SQUARED ERRORS-SSE=   214.75
MEAN OF DEPENDENT VARIABLE =   2.3038


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.43754     0.1398       3.129     0.002 0.251      0.4603     0.3620
```

```
LCL        0.26182      0.7053E-01   3.712      0.000 0.294     0.2908      0.9701
LCW       -0.82693E-01 0.1440      -0.5743      0.566-0.047    -0.0452     -0.1998
LCD       -0.43423      0.3902      -1.113      0.266-0.092    -0.0939     -0.4922
LQ         0.27698E-01 0.8015E-01  0.3456       0.730 0.029     0.0289      0.1957
LTF       -0.13980      0.5941E-01  -2.353      0.019-0.191    -0.1757     -1.5847
CONSTANT   4.0290       1.811       2.225       0.026 0.181     0.0000      1.7488

DURBIN-WATSON = 1.2255    VON NEUMANN RATIO = 1.2336    RHO =  0.38355
RESIDUAL SUM =  0.26001E-12  RESIDUAL VARIANCE =   1.4036
SUM OF ABSOLUTE ERRORS=   143.91
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2802
RUNS TEST:   57 RUNS,   79 POS,    0 ZERO,   74 NEG  NORMAL STATISTIC = -3.3159
COEFFICIENT OF SKEWNESS =  -0.4527 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0871 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=     5.2209 P-VALUE= 0.074

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  1.0  8.0  6.0  8.0 16.0 20.0 28.0 18.0 18.0 20.0  7.0  2.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   18.0309 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.006

 |_2sls ltrfb ltrfc lbl lbd lq ltf (lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl
dpraf dpraus dprea dprna dprnwe dprsa dprwa
 | me)/ dn rstat gf
  TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
  17 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
       153 OBSERVATIONS
 DN OPTION IN EFFECT - DIVISOR IS N

  R-SQUARE =    0.2102     R-SQUARE ADJUSTED =    0.1834
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.6997
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.3037
 SUM OF SQUARED ERRORS-SSE=    260.05
 MEAN OF DEPENDENT VARIABLE =    1.9062


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      0.44634      0.1900       2.350      0.019 0.190     0.4243      0.5394
LBL        0.46818E-02 0.1522      0.3076E-01 0.975 0.003     0.0030      0.0205
LBD       -0.63443      0.5167      -1.228      0.220-0.101    -0.1040     -0.7885
LQ        -0.12505      0.1028      -1.217      0.224-0.100    -0.1239     -1.0679
LTF        0.15497      0.6456E-01   2.400      0.016 0.194     0.1852      2.1231
CONSTANT   0.33056      1.983       0.1667      0.868 0.014     0.0000      0.1734

DURBIN-WATSON = 1.1664    VON NEUMANN RATIO = 1.1740    RHO =  0.41059
RESIDUAL SUM = -0.68512E-12  RESIDUAL VARIANCE =   1.6997
SUM OF ABSOLUTE ERRORS=   154.97
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2106
RUNS TEST:   52 RUNS,   74 POS,    0 ZERO,   79 NEG  NORMAL STATISTIC = -4.1279
COEFFICIENT OF SKEWNESS =  -0.1782 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.0871 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=     0.8073 P-VALUE= 0.668

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  0.0  5.0  3.0  4.0  9.0 16.0 28.0 27.0 22.0 15.0  7.0 13.0  2.0  2.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   23.1485 WITH  7 DEGREES OF FREEDOM, P-VALUE= 0.002
 |_**********************************************

 |_2sls ltrfc ltrfb lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
dprea dprna dprnwe dprsa dprwame ( lbl lbd
 |  lcl lcw lcd lq ltf dpm&
 | pa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn
```

```
rstat gf
  TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
  20 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
       153 OBSERVATIONS
 DN OPTION IN EFFECT - DIVISOR IS N

  R-SQUARE =    0.2928     R-SQUARE ADJUSTED =    0.1917
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.3753
 STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.1727
 SUM OF SQUARED ERRORS-SSE=   210.42
 MEAN OF DEPENDENT VARIABLE =    2.3038


                                        ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFB      0.76097     0.8971      0.8482     0.396 0.073      0.8005     0.6297
 LCL        0.22659     0.1055       2.148     0.032 0.183      0.2517     0.8396
 LCW       -0.18105     0.2033     -0.8906     0.373-0.077     -0.0989    -0.4374
 LCD       -0.27351     0.6551     -0.4175     0.676-0.036     -0.0591    -0.3101
 LQ         0.93541E-01 0.1003      0.9327     0.351 0.081      0.0975     0.6610
 LTF       -0.10015     0.7070E-01  -1.417     0.157-0.122     -0.1259    -1.1353
 DPMPA      -1.0676     0.6758      -1.580     0.114-0.136     -0.3572    -0.3150
 DPMPCR     -1.0952     0.7540      -1.453     0.146-0.125     -0.2264    -0.0435
 DPMLC     -0.64526     0.7008     -0.9207     0.357-0.080     -0.1860    -0.0567
 DPGLL     -0.29676     0.5882     -0.5045     0.614-0.044     -0.1062    -0.0606
 DPGS       0.43478     0.8221      0.5288     0.597 0.046      0.1282     0.0407
 DPGSL      0.25600     0.5942      0.4309     0.667 0.037      0.0825     0.0312
 DPRAF     -0.27915     0.6179     -0.4517     0.651-0.039     -0.0495    -0.0079
 DPRAUS     0.46455     0.5578      0.8328     0.405 0.072      0.0929     0.0171
 DPREA     -0.11004     0.7054     -0.1560     0.876-0.014     -0.0292    -0.0078
 DPRNA     -0.14401     0.5611     -0.2567     0.797-0.022     -0.0243    -0.0037
 DPRNWE    -0.56978      1.039     -0.5483     0.584-0.047     -0.1885    -0.0760
 DPRSA      0.28956     0.4878      0.5937     0.553 0.051      0.0742     0.0189
 DPRWAME    0.54596     0.8242      0.6624     0.508 0.057      0.1092     0.0201
 CONSTANT    2.7547      3.608      0.7635     0.445 0.066      0.0000     1.1957

 DURBIN-WATSON = 1.3632    VON NEUMANN RATIO = 1.3721    RHO =  0.31412
 RESIDUAL SUM =  0.40457E-12  RESIDUAL VARIANCE =    1.3753
 SUM OF ABSOLUTE ERRORS=   145.23
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3702
 RUNS TEST:    61 RUNS,    78 POS,     0 ZERO,    75 NEG  NORMAL STATISTIC = -2.6730
 COEFFICIENT OF SKEWNESS =    0.1082 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =  -0.3343 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=     1.1299 P-VALUE= 0.568

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  0.0   0.0   0.0   0.0   0.0   5.0   7.0   3.0   4.0   8.0   5.0 10.0   9.0 15.0   9.0 13.0
11.0 10.0 11.0 12.0
           6.0   1.0   5.0   3.0   2.0   0.0   2.0   2.0   0.0   0.0
 EXPECTED  0.4   0.3   0.5   0.9   1.4   2.0   2.9   4.0   5.2   6.7   8.1   9.5 10.8 11.6 12.1 12.1
11.6 10.8   9.5   8.1
           6.7   5.2   4.0   2.9   2.0   1.4   0.9   0.5   0.3   0.4
 CHI-SQUARE =    31.4203 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.000

 |_2sls ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame (lbl lbd lcl
 | lcd lq ltf  dpmpa dpmpc&
 | r dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf
  TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
  19 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
       153 OBSERVATIONS
 DN OPTION IN EFFECT - DIVISOR IS N

  R-SQUARE =    0.3678     R-SQUARE ADJUSTED =    0.2828
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VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.3606
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.1664
SUM OF SQUARED ERRORS-SSE=   208.17
MEAN OF DEPENDENT VARIABLE =   1.9062


                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      0.35540    0.1989       1.787     0.074 0.153     0.3378     0.4295
LBL       -0.60906E-01 0.1452     -0.4195    0.675-0.036    -0.0388    -0.2666
LBD       -0.11853    0.5303     -0.2235     0.823-0.019    -0.0194    -0.1473
LQ        -0.72798E-01 0.1050     -0.6932    0.488-0.060    -0.0721    -0.6217
LTF        0.43326E-01 0.7148E-01  0.6061    0.544 0.052     0.0518     0.5936
DPMPA      0.38370    0.6875      0.5581     0.577 0.048     0.1220     0.1368
DPMPCR     0.40165    0.7609      0.5278     0.598 0.046     0.0789     0.0193
DPMLC      0.40266    0.6766      0.5951     0.552 0.051     0.1103     0.0428
DPGLL      0.46169E-02 0.5352     0.8626E-02 0.993 0.001     0.0016     0.0011
DPGS      -0.54118    0.5802     -0.9327     0.351-0.080    -0.1517    -0.0612
DPGSL     -0.20510    0.5381     -0.3811     0.703-0.033    -0.0628    -0.0302
DPRAF     -0.11558    0.5308     -0.2177     0.828-0.019    -0.0195    -0.0040
DPRAUS     0.53132E-01 0.5252      0.1012     0.919 0.009     0.0101     0.0024
DPREA     -0.33387    0.4345     -0.7684     0.442-0.066    -0.0841    -0.0286
DPRNA      0.25267E-02 0.5485     0.4606E-02 0.996 0.000     0.0004     0.0001
DPRNWE     0.99294    0.3930       2.527     0.012 0.213     0.3123     0.1600
DPRSA      0.58310E-01 0.4605      0.1266     0.899 0.011     0.0142     0.0046
DPRWAME   -0.68721    0.4707      -1.460     0.144-0.125    -0.1306    -0.0306
CONSTANT    1.5252     2.138      0.7132     0.476 0.061     0.0000     0.8001

DURBIN-WATSON = 1.2920    VON NEUMANN RATIO = 1.3005    RHO =  0.34892
RESIDUAL SUM = -0.34894E-12  RESIDUAL VARIANCE =   1.3606
SUM OF ABSOLUTE ERRORS=   141.76
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3686
RUNS TEST:   45 RUNS,   76 POS,    0 ZERO,   77 NEG  NORMAL STATISTIC = -5.2720
COEFFICIENT OF SKEWNESS =  -0.4388 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.1311 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.8626 P-VALUE= 0.088

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  1.0  0.0  1.0  4.0  0.0  1.0  6.0  2.0  2.0  2.0  9.0 11.0 11.0 13.0 14.0 12.0
7.0  6.0  7.0 22.0
       9.0  5.0  3.0  3.0  0.0  1.0  0.0  1.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   58.4892 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
|_**ommiting ltrfb as it is found to be not endogenous

|_2sls ltrfc lcl lcw lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame (lbl lbd lcl lc
| w lcd lq ltf dpmpa dpmp&
| cr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
 20 EXOGENOUS VARIABLES
  1 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =    0.3110     R-SQUARE ADJUSTED =    0.2184
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.3399
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.1575
SUM OF SQUARED ERRORS-SSE=   205.00
MEAN OF DEPENDENT VARIABLE =   2.3038


                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
```

```
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LCL       0.29160     0.7153E-01   4.077     0.000 0.332     0.3239      1.0805
LCW      -0.64175E-01 0.1475     -0.4350     0.664-0.038    -0.0350     -0.1550
LCD      -0.70475     0.4078      -1.728     0.084-0.148    -0.1524     -0.7989
LQ        0.49067E-01 0.8439E-01  0.5814     0.561 0.050     0.0511      0.3467
LTF      -0.11068     0.6870E-01  -1.611     0.107-0.138    -0.1391     -1.2546
DPMPA     -1.0410     0.6663      -1.562     0.118-0.134    -0.3483     -0.3072
DPMPCR    -1.0331     0.7407      -1.395     0.163-0.120    -0.2136     -0.0410
DPMLC    -0.52903     0.6784     -0.7798     0.436-0.067    -0.1525     -0.0465
DPGLL    -0.49319     0.5337     -0.9240     0.355-0.080    -0.1765     -0.1007
DPGS     -0.51393E-01 0.5818     -0.8834E-01 0.930-0.008    -0.0152     -0.0048
DPGSL     0.41492E-01 0.5307      0.7819E-01 0.938 0.007     0.0134      0.0051
DPRAF    -0.56048     0.5146      -1.089     0.276-0.094    -0.0993     -0.0159
DPRAUS    0.67923     0.4906       1.384     0.166 0.119     0.1358      0.0251
DPREA    -0.58562     0.4226      -1.386     0.166-0.119    -0.1553     -0.0415
DPRNA    -0.25117     0.5396     -0.4655     0.642-0.040    -0.0424     -0.0064
DPRNWE    0.24669     0.3867      0.6379     0.524 0.055     0.0816      0.0329
DPRSA     0.47039     0.4330       1.086     0.277 0.093     0.1206      0.0307
DPRWAME  -0.28132E-01 0.4643     -0.6059E-01 0.952-0.005    -0.0056     -0.0010
CONSTANT   5.1901      2.157       2.406     0.016 0.204     0.0000      2.2528

DURBIN-WATSON = 1.5322    VON NEUMANN RATIO = 1.5423    RHO =  0.23137
RESIDUAL SUM =  0.43610E-12  RESIDUAL VARIANCE =   1.3399
SUM OF ABSOLUTE ERRORS=   132.01
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3110
RUNS TEST:   67 RUNS,   76 POS,    0 ZERO,   77 NEG  NORMAL STATISTIC = -1.7029
COEFFICIENT OF SKEWNESS =  -1.0366 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   3.9331 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=  117.3165 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  2.0  0.0  1.0  0.0  0.0  2.0  2.0  2.0  5.0  6.0  6.0  8.0 11.0 13.0 19.0  9.0
16.0 12.0  7.0 11.0
          3.0  7.0  7.0  2.0  1.0  0.0  1.0  0.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   28.1941 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.001

|_2sls ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame (lbl lbd lcl
| lcd lq ltf  dpmpa dpmpc&
| r dpmlc dpgll dpgs dpgsl dpraf dpraus dprea dprna dprnwe dprsa dprwame)/ dn rstat gf
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
 19 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.3678     R-SQUARE ADJUSTED =   0.2828
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3606
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1664
SUM OF SQUARED ERRORS-SSE=   208.17
MEAN OF DEPENDENT VARIABLE =   1.9062


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.35540     0.1989       1.787     0.074 0.153     0.3378      0.4295
LBL      -0.60906E-01 0.1452     -0.4195     0.675-0.036    -0.0388     -0.2666
LBD      -0.11853     0.5303     -0.2235     0.823-0.019    -0.0194     -0.1473
LQ       -0.72798E-01 0.1050     -0.6932     0.488-0.060    -0.0721     -0.6217
LTF       0.43326E-01 0.7148E-01  0.6061     0.544 0.052     0.0518      0.5936
DPMPA     0.38370     0.6875      0.5581     0.577 0.048     0.1220      0.1368
DPMPCR    0.40165     0.7609      0.5278     0.598 0.046     0.0789      0.0193
DPMLC     0.40266     0.6766      0.5951     0.552 0.051     0.1103      0.0428
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 DPGLL     0.46169E-02 0.5352      0.8626E-02 0.993 0.001     0.0016     0.0011
 DPGS     -0.54118     0.5802     -0.9327     0.351-0.080    -0.1517    -0.0612
 DPGSL    -0.20510     0.5381     -0.3811     0.703-0.033    -0.0628    -0.0302
 DPRAF    -0.11558     0.5308     -0.2177     0.828-0.019    -0.0195    -0.0040
 DPRAUS    0.53132E-01 0.5252      0.1012     0.919 0.009     0.0101     0.0024
 DPREA    -0.33387     0.4345     -0.7684     0.442-0.066    -0.0841    -0.0286
 DPRNA     0.25267E-02 0.5485      0.4606E-02 0.996 0.000     0.0004     0.0001
 DPRNWE    0.99294     0.3930      2.527      0.012 0.213     0.3123     0.1600
 DPRSA     0.58310E-01 0.4605      0.1266     0.899 0.011     0.0142     0.0046
 DPRWAME  -0.68721     0.4707     -1.460      0.144-0.125    -0.1306    -0.0306
 CONSTANT   1.5252      2.138      0.7132     0.476 0.061     0.0000     0.8001

 DURBIN-WATSON = 1.2920    VON NEUMANN RATIO = 1.3005    RHO =  0.34892
 RESIDUAL SUM = -0.34894E-12  RESIDUAL VARIANCE =    1.3606
 SUM OF ABSOLUTE ERRORS=   141.76
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3686
 RUNS TEST:   45 RUNS,    76 POS,     0 ZERO,    77 NEG  NORMAL STATISTIC = -5.2720
 COEFFICIENT OF SKEWNESS =  -0.4388 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =   0.1311 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.8626 P-VALUE= 0.088

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  1.0  0.0  1.0  4.0  0.0  1.0  6.0  2.0  2.0  2.0  9.0 11.0 11.0 13.0 14.0 12.0
7.0  6.0  7.0 22.0
           9.0  5.0  3.0  3.0  0.0  1.0  0.0  1.0  0.0  0.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   58.4892 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_*3stage leat square

 |_system 2 lcl lcw lcd lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
dprea dprna dprnwe dprsa dprwame/ dn
 |_ols ltrfc ltrfb lcl lcw lcd  lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus
dprea dprna dprnwe dprsa dprwame
 |_ols ltrfb ltrfc lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf dpraus dprea
dprna dprnwe dprsa dprwame

 THREE STAGE LEAST SQUARES--    2 EQUATIONS
  20 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
   37 RIGHT-HAND SIDE VARIABLES IN SYSTEM
 MAX ITERATIONS =        1         CONVERGENCE TOLERANCE =   0.10000E-02
      153 OBSERVATIONS
 DN OPTION IN EFFECT - DIVISOR IS N

 ITERATION     0 COEFFICIENTS
   0.76097      0.22659     -0.18105     -0.27351      0.93541E-01 -0.10015
  -1.0676      -1.0952      -0.64526     -0.29676      0.43478      0.25600
  -0.27915      0.46455     -0.11004     -0.14401     -0.56978      0.28956
   0.54596      0.34474     -0.61729E-01 -0.12874     -0.70875E-01  0.42907E-01
   0.37565      0.39341      0.40094      0.22810E-02 -0.53965     -0.20252
  -0.12170      0.61829E-01 -0.33896     -0.24534E-02  0.99309      0.63806E-01
  -0.68610

 ITERATION    0 SIGMA
    1.3753
  -0.93905       1.3629
 LOG OF DETERMINANT OF SIGMA= -0.74872E-02

 ITERATION    1 SIGMA INVERSE
    1.3731
   0.94610       1.3856

 ITERATION     1 COEFFICIENTS
   0.97641      0.19667     -0.80215E-01 -0.37710      0.12451     -0.10398
  -1.0850      -1.1075      -0.75268     -0.30041      0.50831      0.25770
```

```
 -0.23138      0.38555     -0.35309E-01 -0.17117     -0.81383      0.20531
  0.67659      0.33835     -0.51206E-01 -0.19808     -0.68476E-01  0.43359E-01
  0.36828      0.38835      0.39726     -0.12565E-01 -0.55259     -0.21654
 -0.12129      0.77875E-01 -0.35293     -0.84482E-02  0.98419      0.72277E-01
 -0.67797

ITERATION    1 SIGMA
   1.7283
  -1.2445       1.3646
LOG OF DETERMINANT OF SIGMA= -0.21120

SYSTEM R-SQUARE =  0.7705
TEST OF THE OVERALL SIGNIFICANCE =   225.16
CHI-SQUARE WITH   37 D.F.     P-VALUE= 0.00000

VARIABLE       COEFFICIENT    ST.ERROR       T-RATIO
LTRFB       0.97641        0.88270         1.1062
LCL         0.19667        0.99360E-01     1.9794
LCW        -0.80215E-01    0.18922        -0.42393
LCD        -0.37710        0.61290        -0.61528
LQ          0.12451        0.95971E-01     1.2974
LTF        -0.10398        0.70647E-01    -1.4719
DPMPA       -1.0850        0.67561        -1.6059
DPMPCR      -1.1075        0.75303        -1.4708
DPMLC      -0.75268        0.69627        -1.0810
DPGLL      -0.30041        0.58647        -0.51224
DPGS        0.50831        0.81682         0.62230
DPGSL       0.25770        0.59296         0.43459
DPRAF      -0.23138        0.61664        -0.37522
DPRAUS      0.38555        0.55478         0.69496
DPREA      -0.35309E-01    0.70229        -0.50277E-01
DPRNA      -0.17117        0.55959        -0.30588
DPRNWE     -0.81383         1.0237        -0.79496
DPRSA       0.20531        0.48311         0.42497
DPRWAME     0.67659        0.81860         0.82653
LTRFC       0.33835        0.19697         1.7178
LBL        -0.51206E-01    0.13779        -0.37161
LBD        -0.19808        0.43516        -0.45517
LQ         -0.68476E-01    0.10457        -0.65486
LTF         0.43359E-01    0.71516E-01     0.60629
DPMPA       0.36828        0.68728         0.53585
DPMPCR      0.38835        0.76122         0.51017
DPMLC       0.39726        0.67702         0.58678
DPGLL      -0.12565E-01    0.53169        -0.23631E-01
DPGS       -0.55259        0.57793        -0.95615
DPGSL      -0.21654        0.53504        -0.40471
DPRAF      -0.12129        0.53124        -0.22832
DPRAUS      0.77875E-01    0.52088         0.14951
DPREA      -0.35293        0.43051        -0.81979
DPRNA      -0.84482E-02    0.54837        -0.15406E-01
DPRNWE      0.98419        0.39137         2.5147
DPRSA       0.72277E-01    0.45932         0.15735
DPRWAME    -0.67797        0.46977        -1.4432
 EQUATION  1 OF  2 EQUATIONS
DEPENDENT VARIABLE = LTRFC                153 OBSERVATIONS

 R-SQUARE =    0.1113
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.7283
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3146
SUM OF SQUARED ERRORS-SSE=   264.42
MEAN OF DEPENDENT VARIABLE =   2.3038


                               ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME     COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.97641     0.8827        1.106     0.269 0.095      1.0272      0.8079
LCL        0.19667     0.9936E-01    1.979     0.048 0.169      0.2185      0.7287
```

```
LCW      -0.80215E-01 0.1892     -0.4239     0.672-0.037    -0.0438    -0.1938
LCD      -0.37710     0.6129     -0.6153     0.538-0.053    -0.0816    -0.4275
LQ        0.12451     0.9597E-01  1.297      0.194 0.112     0.1298     0.8798
LTF      -0.10398     0.7065E-01 -1.472      0.141-0.127    -0.1307    -1.1787
DPMPA     -1.0850     0.6756      -1.606     0.108-0.138    -0.3630    -0.3201
DPMPCR    -1.1075     0.7530      -1.471     0.141-0.127    -0.2290    -0.0440
DPMLC    -0.75268     0.6963      -1.081     0.280-0.093    -0.2170    -0.0662
DPGLL    -0.30041     0.5865     -0.5122     0.608-0.044    -0.1075    -0.0614
DPGS      0.50831     0.8168      0.6223     0.534 0.054     0.1499     0.0476
DPGSL     0.25770     0.5930      0.4346     0.664 0.038     0.0831     0.0314
DPRAF    -0.23138     0.6166     -0.3752     0.707-0.033    -0.0410    -0.0066
DPRAUS    0.38555     0.5548      0.6950     0.487 0.060     0.0771     0.0142
DPREA    -0.35309E-01 0.7023     -0.5028E-01 0.960-0.004    -0.0094    -0.0025
DPRNA    -0.17117     0.5596     -0.3059     0.760-0.027    -0.0289    -0.0044
DPRNWE   -0.81383      1.024     -0.7950     0.427-0.069    -0.2692    -0.1085
DPRSA     0.20531     0.4831      0.4250     0.671 0.037     0.0526     0.0134
DPRWAME   0.67659     0.8186      0.8265     0.409 0.071     0.1353     0.0250
CONSTANT   1.9941      3.500      0.5698     0.569 0.049     0.0000     0.8656
 EQUATION  2 OF  2 EQUATIONS
DEPENDENT VARIABLE = LTRFB              153 OBSERVATIONS

 R-SQUARE =   0.3659
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3646
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1682
SUM OF SQUARED ERRORS-SSE=   208.79
MEAN OF DEPENDENT VARIABLE =   1.9062


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.33835     0.1970      1.718      0.086 0.147     0.3216     0.4089
LBL      -0.51206E-01 0.1378     -0.3716     0.710-0.032    -0.0326    -0.2241
LBD      -0.19808     0.4352     -0.4552     0.649-0.039    -0.0325    -0.2462
LQ       -0.68476E-01 0.1046     -0.6549     0.513-0.056    -0.0678    -0.5848
LTF       0.43359E-01 0.7152E-01  0.6063     0.544 0.052     0.0518     0.5940
DPMPA     0.36828     0.6873      0.5358     0.592 0.046     0.1171     0.1313
DPMPCR    0.38835     0.7612      0.5102     0.610 0.044     0.0763     0.0186
DPMLC     0.39726     0.6770      0.5868     0.557 0.051     0.1088     0.0422
DPGLL    -0.12565E-01 0.5317     -0.2363E-01 0.981-0.002    -0.0043    -0.0031
DPGS     -0.55259     0.5779     -0.9561     0.339-0.082    -0.1549    -0.0625
DPGSL    -0.21654     0.5350     -0.4047     0.686-0.035    -0.0664    -0.0319
DPRAF    -0.12129     0.5312     -0.2283     0.819-0.020    -0.0204    -0.0042
DPRAUS    0.77875E-01 0.5209      0.1495     0.881 0.013     0.0148     0.0035
DPREA    -0.35293     0.4305     -0.8198     0.412-0.071    -0.0889    -0.0303
DPRNA    -0.84482E-02 0.5484     -0.1541E-01 0.988-0.001    -0.0014    -0.0003
DPRNWE    0.98419     0.3914      2.515      0.012 0.212     0.3095     0.1586
DPRSA     0.72277E-01 0.4593      0.1574     0.875 0.014     0.0176     0.0057
DPRWAME  -0.67797     0.4698     -1.443      0.149-0.124    -0.1289    -0.0302
CONSTANT   1.6291      2.123      0.7675     0.443 0.066     0.0000     0.8546
|_end
|_**Ommiting insignificant variable- lcw- and re-run 2SLS

|_2sls ltrfc ltrfb lcl lcd lbl lbd ltf ( lcl lcd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs
dpgsl dpraf dpraus dprea dprna dprnwe dprsa
|  dprwame)/ dn
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
 17 EXOGENOUS VARIABLES
  4 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.0823     R-SQUARE ADJUSTED =   0.0446
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.7845
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3359
SUM OF SQUARED ERRORS-SSE=   273.03
MEAN OF DEPENDENT VARIABLE =   2.3038
```

```
                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.58500    0.1795       3.259      0.001 0.260      0.6154      0.4840
LCL        0.24119    0.7733E-01   3.119      0.002 0.250      0.2679      0.8937
LCD        -1.3207    0.5025      -2.628      0.009-0.213     -0.2856     -1.4971
LBL       -0.44910    0.2021      -2.222      0.026-0.181     -0.3007     -1.6265
LBD         3.0359     1.152       2.635      0.008 0.213      0.5236      3.1221
LTF       -0.14753    0.7831E-01  -1.884      0.060-0.154     -0.1855     -1.6723
CONSTANT   2.9860      2.156       1.385      0.166 0.114      0.0000      1.2961

|_2sls ltrfb ltrfc lbl lq ltf (lbl lbd lq ltf dpmpa dpmpcr dpmlc dpgll dpgs dpgsl dpraf
dpraus dprea dprna dprnwe dprsa dprwame)/
|  dn
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
 17 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.1978     R-SQUARE ADJUSTED =    0.1761
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.7264
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.3139
SUM OF SQUARED ERRORS-SSE=   264.14
MEAN OF DEPENDENT VARIABLE =    1.9062


                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      0.50367    0.1856       2.714      0.007 0.218      0.4788      0.6087
LBL        0.37019E-01 0.1511      0.2450     0.806 0.020      0.0236      0.1620
LQ        -0.18505    0.9110E-01  -2.031      0.042-0.165     -0.1833     -1.5803
LTF        0.14883    0.6487E-01   2.294      0.022 0.185      0.1778      2.0390
CONSTANT -0.43739      1.896      -0.2307     0.818-0.019      0.0000     -0.2295
```

APPENDIX VI: MODEL SPECIFICATION TESTS-COMMNADS


```
sample 1 153
read (wpdata153.shd) trfc trfb bl bd  cl cw cd q tf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam
GENR ltrfc=LOG(trfc)
GENR ltrfb=LOG(trfb)
GENR lbl=LOG(bl)
GENR lbd=LOG(bd)
GENR lcl=LOG(cl)
GENR lcw=LOG(cw)
GENR lcd=LOG(cd)
GENR lq=LOG(q)
GENR ltf=LOG(tf)
OLS ltrfc ltrfb lbd lbl lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam/ hetcov
*model specification test
diagnos / reset
OLS ltrfb ltrfc lbl lbd lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam/ hetcov
*model specification test
diagnos / reset
OLS ltrfc ltrfb lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam/ hetcov
*model specification test
diagnos / reset
OLS ltrfb ltrfc lbl lbd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam/ hetcov
*model specification test
diagnos / reset
*************************************2sls for trfc
**Hausman Specification test for errors in variables-Simultaneity check
* Estimation using the consistent estimator (IV) under both
* the null and the alternative hypotheses;
* in SHAZAM, the 2SLS command is used for instrumental variable estimation
sample 1 153
**Instrumental varaible is berth depth, assuming it has an impact on channel dues through berth occupancy charge
2SLS ltrfc ltrfb (lbd ) / DN COEF=B1C PCOV COV=V1C
GEN1 SIGIVC=$SIG2
* Estimation using the efficient estimator (OLS) under the null
OLS ltrfc ltrfb / DN COEF=B0C COV=V0C NOMULSIGSQ
* Use the error variance estimate obtained from IV estimation.
MATRIX V0C=SIGIVC*V0C
PRINT V0C
* Compute the Hausman specification test statistic using the method
* illustrated in Griffiths, Hill and Judge (1993, p. 465)
SAMPLE 1 2
GENR QC=B1C-B0C
MATRIX VQC=V1C-V0C
```

```
MATRIX MC=(QC(1)**2) / VQC(1,1)
* The statistic M is distributed chi-square with 1 degree of freedom
* under the null hypothesis. The 5% critical value is 3.84.
PRINT MC
**As M statistics, which Hausmand Speci test statistics is significant at 5% (M<3.84), we reject null hypothesis that there are no errors in
end
**Instrumental varaible is berth length, assuming it has an impact on channel dues through berth occupancy charge
sample 1 153
2SLS ltrfc ltrfb (lbl) / DN COEF=B1C1 PCOV COV=V1C1
GEN1 SIGIVC1=$SIG2
* Estimation using the efficient estimator (OLS) under the null
OLS ltrfc ltrfb / DN COEF=B0C1 COV=V0C1 NOMULSIGSQ
* Use the error variance estimate obtained from IV estimation.
MATRIX V0C1=SIGIVC1*V0C1
PRINT V0C1
* Compute the Hausman specification test statistic using the method
* illustrated in Griffiths, Hill and Judge (1993, p. 465)
SAMPLE 1 2
GENR QC1=B1C1-B0C1
MATRIX VQC1=V1C1-V0C1
MATRIX MC1=(QC1(1)**2) / VQC1(1,1)
* The statistic M is distributed chi-square with 1 degree of freedom
* under the null hypothesis. The 5% critical value is 3.84.
PRINT MC1
end
**Instrumental varaible is berth length and berth depth, assuming it has an impact on channel dues through berth occupancy charge
sample 1 153
2SLS ltrfc ltrfb (lbl lbd ) / DN COEF=B1C1 PCOV COV=V1C1
GEN1 SIGIVC1=$SIG2
* Estimation using the efficient estimator (OLS) under the null
OLS ltrfc ltrfb / DN COEF=B0C1 COV=V0C1 NOMULSIGSQ
* Use the error variance estimate obtained from IV estimation.
MATRIX V0C1=SIGIVC1*V0C1
PRINT V0C1
* Compute the Hausman specification test statistic using the method
* illustrated in Griffiths, Hill and Judge (1993, p. 465)
SAMPLE 1 2
GENR QC1=B1C1-B0C1
MATRIX VQC1=V1C1-V0C1
MATRIX MC1=(QC1(1)**2) / VQC1(1,1)
* The statistic M is distributed chi-square with 1 degree of freedom
* under the null hypothesis. The 5% critical value is 3.84.
PRINT MC1
**Instrumental varaible is berth length, assuming it has an impact on berth occupancy charge through channel due
sample 1 153
2SLS ltrfb ltrfc (lbl) / DN COEF=B3 PCOV COV=V3
```

```
GEN1 SIGIVB=$SIG2
OLS ltrfb ltrfc / DN COEF=B2 COV=V2 NOMULSIGSQ
* Use the error variance estimate obtained from IV estimation.
MATRIX V2=SIGIVB*V2
PRINT V2
* Compute the Hausman specification test statistic using the method
* illustrated in Griffiths, Hill and Judge (1993, p. 465)
SAMPLE 1 2
GENR QB=B3-B2
MATRIX VQB=V3-V2
MATRIX MB=(QB(1)**2) / VQB(1,1)
* The statistic M is distributed chi-square with 1 degree of freedom
* under the null hypothesis. The 5% critical value is 3.84.
PRINT MB


**Instrumental varaible is berth depth, assuming it has an impact on berth occupancy charge through channel due
sample 1 153
2SLS ltrfb ltrfc (lbd) / DN COEF=B3B1 PCOV COV=V3B1
GEN1 SIGIVB1=$SIG2
OLS ltrfb ltrfc / DN COEF=B2B1 COV=V2B1 NOMULSIGSQ
* Use the error variance estimate obtained from IV estimation.
MATRIX V2B1=SIGIVB1*V2B1
PRINT V2B1
* Compute the Hausman specification test statistic using the method
* illustrated in Griffiths, Hill and Judge (1993, p. 465)
SAMPLE 1 2
GENR QB1=B3B1-B2B1
MATRIX VQB1=V3B1-V2B1
MATRIX MB1=(QB1(1)**2) / VQB1(1,1)
* The statistic M is distributed chi-square with 1 degree of freedom
* under the null hypothesis. The 5% critical value is 3.84.
PRINT MB1


**Instrumental varaible is berth lenght, depth, assuming it has an impact on berth occupancy charge through channel due
sample 1 153
2SLS ltrfb ltrfc (lbl lbd) / DN COEF=B3 PCOV COV=V3
GEN1 SIGIVB=$SIG2
OLS ltrfb ltrfc / DN COEF=B2 COV=V2 NOMULSIGSQ
* Use the error variance estimate obtained from IV estimation.
MATRIX V2=SIGIVB*V2
PRINT V2
* Compute the Hausman specification test statistic using the method
* illustrated in Griffiths, Hill and Judge (1993, p. 465)
SAMPLE 1 2
GENR QB=B3-B2
MATRIX VQB=V3-V2
MATRIX MB=(QB(1)**2) / VQB(1,1)
* The statistic M is distributed chi-square with 1 degree of freedom
* under the null hypothesis. The 5% critical value is 3.84.
PRINT MB
```

```


******testing for endogeniety of ltrfb
sample 1 153
OLS ltrfb lbl lbd lq ltf / hetcov  resid=V2

*using F test testing lbl and lbd correlate with ltrfb: coefficent of lbl lbd setting equal to 0: require higher F value and significant at 1% or 5%.
TEST lbl=0
TEST lbd=0
end
* Result: lbl is correlated with ltrfb at 5% significant level
sample 1 153
OLS ltrfc ltrfb lbd lcl lcw lcd lq ltf V2/ hetcov
test V2=0
*Testing H0:coefficent of V2 = 0 using t test  and if we reject H0 , ltrfb is endogenous varaible. Since T stat is large and signififant at 1% we accept that ltrfb is a endogenous varaible.

******Testing for endogeniety of ltrfc
sample 1 153
OLS ltrfc lcl lcw lcd lq ltf / hetcov  resid=V4

*using F test testing lcl, lcw and lcd correlate with ltrfc: coefficents of lcl, clw, and lccd setting equal to 0: require higher F value and significant at 1%.
TEST lcl=0
TEST lcw=0
TEST lcd=0
end
*Result : lcl and lcd correlate with ltrfc at % sig level
sample 1 153
OLS ltrfb ltrfc lbl lbd lq ltf V4/ hetcov
Test V4=0

*Testing H0:coefficent of V4 =  0 using t test  and if we reject H0 , ltrfc is endogenous varaible. Since T stat is small and not signififant at 1% we do not accept that ltrfc is a endogenous varaible.


* We have a system of equation in the form
sample 1 153
2sls ltrfb ltrfc  (lbl lbd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam)/ dn gf

OLS ltrfc ltrfb lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam/ hetcov
*model specification test
diagnos / reset

************testing for over identification******************************************************************************************
***LtrfcI

sample 1 153
```

```
2SLS ltrfc ltrfb lcw (lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam ) / resid=U1
*regress 2SLS residual U1 on all exogeneous varaibles
OLS U1 lcl lcw lcd lq ltf/ hetcov
GEN1 teststat=$N*$R2
GEN1 k=2-1
sample 1 1
Distrib teststat / type=CHI df=k cdf=cdf
GEN1 p_value=1-cdf
print teststat p_value

**ltrfcII
sample 1 153
2SLS ltrfc ltrfb lcl (lcl lcw lcd lq ltf ) / resid=U1
*regress 2SLS residual U1 on all exogeneous varaibles
OLS U1 lcl lcw lcd lq ltf/ hetcov
GEN1 teststat=$N*$R2
GEN1 k=2-1
sample 1 1
Distrib teststat / type=CHI df=k cdf=cdf
GEN1 p_value=1-cdf
print teststat p_value


**ltrfbI
sample 1 153
2SLS ltrfb ltrfc lbl (lbl lbd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna dprnwe dprsa dprwam)/ resid=U2 gf

OLS U2 lbd lcl lcw lcd lq ltf/ hetcov

GEN1 testst1=$N*$R2
GEN1 k1=2-1
sample 1 1
Distrib testst1 / type=CHI df=k1 cdf=cdf1
GEN1 p_value1=1-cdf1
print testst1 p_value1

**ltrfbII
sample 1 153
2SLS ltrfb ltrfc lbl (lbl lbd lq ltf )/ resid=U2 gf

OLS U2 lbd lcl lcw lcd lq ltf/ hetcov

GEN1 testst1=$N*$R2
GEN1 k1=2-1
sample 1 1
Distrib testst1 / type=CHI df=k1 cdf=cdf1
GEN1 p_value1=1-cdf1
print testst1 p_value1
stop
***************************************************************************************************************


*Testing for Heteroskedasticity 2SLS
```

```
sample 1 153
2SLS ltrfc ltrfb lcl lcd (lbd lcl lcw lcd lq ltf )/ resid=U1
OLS U1 lbd lcl lcw lcd lq ltf
GEN1 teststat=$N*$R2
GEN1 k=3-1
sample 1 1
DISTRIB teststat / type=chi df=k cdf=cdf
GEN1 p_value=1-cdf
print teststat p_value
sample 1 153
GENR U1SQ=U1**2
OLS U1SQ lcl lcw lcd lbd lq ltf/ anova
*Het robust se
2SLS ltrfc ltrfb lcl lcw lcd (lbd lcl lcw lcd lq ltf )/ resid=U1 coef=beta stderr=se2sls
GEN1 df1=$df
GEN1 K=$K
GENR U1SQ=U1**2
copy U1SQ U2
GENR one=1
copy ltrfb lcl lcw lcd one X
copy lcl lcw lcd lbd lq ltf one Z
MATRIX X=Z*(INV(Z'Z)*(Z'*X))
MATRIX XINV=INV(X'X)
MATRIX HC= XINV*(X'DIAG(U2)*X)*XINV
MATRIX HSE= SQRT(DIAG(HC))
Sample 1 K
GENR T=beta/HSE
GENR TRA=ABS(T)
DISTRIB TRA/ type=T df=DF1 cdf=cdf1
GENR PVAL=2*(1-cdf1)
FORMAT(7(A8,1X))
READ names / format byvar
*ltrfb lcl lcw lcd
NAMEFMT (1X, A8, 2X, 7(2X, A8))
FORMAT (1X, A8,7F10.4,F10.5)
PRINT names beta se2sls HSE T PVAL/ format
end
*testing ltrfc is endogenous
sample 1 153
OLS ltrfc lcl lcw lcd lq ltf/ resid=V2
OLS ltrfb ltrfc lbl lbd lq ltf V2
test V2=0
```

```
*T statistics is large and not siginficant at 1% sig level. So ltrfc is not
endogenous
*testing ltrfb is endogenous
sample 1 153
OLS ltrfb lbl lbd lq ltf/ resid=V3
OLS ltrfc ltrfb lcl lcw lcd lbd lq ltf V3

test V3=0

*T statistics is large and siginficant only at 10% sig level. So ltrfb is
partially endogenous
sample 1 153
OLS ltrfc ltrfb lcl lcw lcd lq ltf/ resid=W2
OLS ltrfb lbl lbd lq ltf/ resid=W3
OLS W2 ltrfb lcl lcw lcd lq ltf W3

sample 1 153
dim
OLS ltrfb ltrfc lbl lbd lcd lq ltf/ resid=W4
OLS ltrfc lcl lcw lcd lq ltf/ resid=W5
OLS W4 ltrfc lbd lbl lq ltf W5


****------------------------------------------------********************
**---------------------------------------
****************Wu Test for ltrfc endogenous test

* Running an OLS regression of ltrfc on ltrfb lcl lcw lcd lq ltf

sample 1 153

OLS ltrfc ltrfb lcl lcw lcd lq ltf

* Specifying the list of exogenous variables in the ltrfc due model as
* z1 = [constant,lcl lcw lcd] and running a 2SLS regression

inst ltrfc ltrfb lcl lcd (lcl lcw lcd)/dn
* Adding lbl to the list of exogenous variables z1

inst ltrfc ltrfb lcl lcw lcd (lcl lcw lcd lbl)/dn

* Testing whether ltrfc is exogenous using the Wu specification test:

* Getting the predicted values in a regression of ltrfb on the first set
* of instrumental variables z1.

OLS ltrfb lcl lcw lcd lq ltf lbl / predict=UU

* Running an OLS regression of ltrfc on independent variables and UU
OLS ltrfc ltrfb lcl lcw lcd lq ltf UU
*
* Testing the null hypothesis that the coefficient of UU is zero. we reject
null hypothesis that UU is 0 which implies that ltrfb is endogenous
test UU

***************Wu Test for ltrfb endogenous test
```

```

* Running an OLS regression of ltrfc on ltrfb lcl lcw lcd lq ltf

sample 1 153

OLS ltrfb ltrfc lbl lbd lq ltf

* Specifying the list of exogenous variables in the ltrfb due model as
* z2 = [constant,lbl lbd ] and running a 2SLS regression

inst ltrfb ltrfc lbl (lbl lbd)/dn

* Adding ltf to the list of exogenous variables z2

inst ltrfb ltrfc lbl lbd (lbl lbd lcl)/dn

* Testing whether ltrfb is exogenous using the Wu specification test:

* Getting the predicted values in a regression of ltrfc on the first set
* of instrumental variables z1.

OLS ltrfc lbl lbd lq lcl lcw lcd / predict=U

* Running an OLS regression of ltrfc on independent variables and U
OLS ltrfb ltrfc lbl lbd lq ltf  U
*
* Testing the null hypothesis that the coefficient of UU is zero. we accpet null hypothesis that UU is 0 which implies that ltrfc is not endogenous
test U

stop
```

APPENDIX VII: MODEL SPECIFICATION TESTS-OUTPUTS

```
 Welcome to SHAZAM (Double Precision) v11.0 -  JUNE 201 Windows7 PAR=112400
 ...NOTE..CURRENT WORKING DIRECTORY IS: C:\Users\ybandara\Documents\Data Analysis
 |_sample 1 153
 |_read (wpdata153.shd) trfc trfb bl bd  cl cw cd q tf dpa dpcor dpc dpgl dpgs dpgsl dpraf
dprau dprea dprna dprnwe dprsa dprwam
 ...NOTE..UNIT 88 IS NOW ASSIGNED TO: wpdata153.shd
 ...NOTE..   22 VARIABLES AND      153 OBSERVATIONS STARTING AT OBS       1

 |_GENR ltrfc=LOG(trfc)
 |_GENR ltrfb=LOG(trfb)
 |_GENR lbl=LOG(bl)
 |_GENR lbd=LOG(bd)
 |_GENR lcl=LOG(cl)
 |_GENR lcw=LOG(cw)
 |_GENR lcd=LOG(cd)
 |_GENR lq=LOG(q)
 |_GENR ltf=LOG(tf)

 |_OLS ltrfc ltrfb lbd lbl lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau
dprea dprna dprnwe dprsa dprwam/ hetcov

 REQUIRED MEMORY IS PAR=      70 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.4221     R-SQUARE ADJUSTED =   0.3295
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.3125
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1456
 SUM OF SQUARED ERRORS-SSE=   171.93
 MEAN OF DEPENDENT VARIABLE =   2.3038
 LOG OF THE LIKELIHOOD FUNCTION = -226.023

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5012
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.40425
  SCHWARZ (1978) CRITERION - LOG SC =             0.84000
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =          1.5329
  HANNAN AND QUINN (1979) CRITERION =              1.7883
  RICE (1984) CRITERION =                          1.5774
  SHIBATA (1981) CRITERION =                       1.4469
  SCHWARZ (1978) CRITERION - SC =                  2.3164
  AKAIKE (1974) INFORMATION CRITERION - AIC =      1.4982

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF             MS              F
 REGRESSION       125.59         21.         5.9806            4.557
 ERROR            171.93        131.         1.3125          P-VALUE
 TOTAL            297.53        152.         1.9574            0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF             MS              F
 REGRESSION       937.64         22.         42.620           32.473
 ERROR            171.93        131.         1.3125          P-VALUE
 TOTAL            1109.6        153.         7.2521            0.000


 VARIABLE   ESTIMATED  STANDARD   T-RATIO       PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR     131 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFB     0.36311     0.1115       3.256     0.001 0.274     0.3820     0.3004
 LBD      -0.25389     0.4795     -0.5295     0.597-0.046    -0.0438    -0.2611
 LBL      -0.35575E-01 0.1182     -0.3011     0.764-0.026    -0.0238    -0.1288
 LCL       0.25739     0.6428E-01   4.004     0.000 0.330     0.2859     0.9537
```

```
 LCW      -0.10285      0.1138      -0.9035     0.368-0.079    -0.0562    -0.2485
 LCD      -0.47887      0.3680       -1.301     0.195-0.113    -0.1036    -0.5429
 LQ        0.10141      0.8638E-01    1.174     0.243 0.102     0.1057     0.7166
 LTF      -0.95372E-01 0.5578E-01   -1.710     0.090-0.148    -0.1199    -1.0811
 DPA       -1.0842      0.5321       -2.037     0.044-0.175    -0.3627    -0.3199
 DPCOR     -1.0954      0.6405       -1.710     0.090-0.148    -0.2265    -0.0435
 DPC      -0.62347      0.5137       -1.214     0.227-0.105    -0.1797    -0.0548
 DPGL     -0.41552      0.3158       -1.316     0.191-0.114    -0.1487    -0.0849
 DPGS      0.14948      0.3693       0.4047     0.686 0.035     0.0441     0.0140
 DPGSL     0.12547      0.3165       0.3964     0.692 0.035     0.0404     0.0153
 DPRAF    -0.40972      0.5843      -0.7012     0.484-0.061    -0.0726    -0.0116
 DPRAU     0.58893      0.3659        1.610     0.110 0.139     0.1178     0.0217
 DPREA    -0.37952      0.3754       -1.011     0.314-0.088    -0.1006    -0.0269
 DPRNA    -0.23497      0.4642      -0.5062     0.614-0.044    -0.0396    -0.0060
 DPRNWE   -0.17442      0.3650      -0.4778     0.634-0.042    -0.0577    -0.0233
 DPRSA     0.34284      0.3601       0.9521     0.343 0.083     0.0879     0.0224
 DPRWAM    0.27320      0.3935       0.6943     0.489 0.061     0.0546     0.0101
 CONSTANT   4.0987       1.801        2.276     0.024 0.195     0.0000     1.7791

 DURBIN-WATSON = 1.4846    VON NEUMANN RATIO = 1.4943    RHO =  0.25442
 RESIDUAL SUM = -0.31175E-12  RESIDUAL VARIANCE =   1.3125
 SUM OF ABSOLUTE ERRORS=   127.30
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4221
 RUNS TEST:   67 RUNS,   81 POS,    0 ZERO,   72 NEG  NORMAL STATISTIC = -1.6662
 COEFFICIENT OF SKEWNESS =  -0.4155 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =   0.5825 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    6.0716 P-VALUE= 0.048

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  1.0  1.0  0.0  0.0  1.0  1.0  3.0  4.0  6.0  3.0  9.0  7.0 14.0 11.0 11.0 12.0
18.0 14.0  6.0  9.0
           8.0  6.0  2.0  3.0  2.0  1.0  0.0  0.0  0.0  0.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   17.8167 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.007
 |_*model specification test
 |_diagnos / reset

 REQUIRED MEMORY IS PAR=      87 CURRENT PAR=  112400
 DEPENDENT VARIABLE = LTRFC          153 OBSERVATIONS
 REGRESSION COEFFICIENTS
   0.363111961248     -0.253885882476     -0.355748019677E-01  0.257385826230
  -0.102851045196     -0.478873251067      0.101407916839     -0.953717103579E-01
   -1.08415119114      -1.09536438413     -0.623469069727     -0.415520853048
   0.149483936339      0.125471015025     -0.409717966166      0.588930859262
  -0.379522503374     -0.234973386652     -0.174415348515      0.342842981689
   0.273195189443       4.09871210146

 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
   RESET(2)=   6.5995     - F WITH DF1=   1 AND DF2= 130 P-VALUE= 0.011
   RESET(3)=   4.0490     - F WITH DF1=   2 AND DF2= 129 P-VALUE= 0.020
   RESET(4)=   4.6746     - F WITH DF1=   3 AND DF2= 128 P-VALUE= 0.004

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETL
  FRESET(1)=   1.8053     - F WITH DF1=   2 AND DF2= 129 P-VALUE= 0.169
  FRESET(2)=   3.7009     - F WITH DF1=   4 AND DF2= 127 P-VALUE= 0.007
  FRESET(3)=   3.3600     - F WITH DF1=   6 AND DF2= 125 P-VALUE= 0.004

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETS
  FRESET(1)=   1.3383     - F WITH DF1=   2 AND DF2= 129 P-VALUE= 0.266
  FRESET(2)=   1.9779     - F WITH DF1=   4 AND DF2= 127 P-VALUE= 0.102
  FRESET(3)=   1.3836     - F WITH DF1=   6 AND DF2= 125 P-VALUE= 0.226

 |_OLS ltrfb ltrfc lbl lbd lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau
dprea dprna dprnwe dprsa dprwam/ hetcov
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REQUIRED MEMORY IS PAR=      70 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:       1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.3793     R-SQUARE ADJUSTED =   0.2797
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.5602
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2491
SUM OF SQUARED ERRORS-SSE=   204.39
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION = -239.251

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.7846
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.57717
 SCHWARZ (1978) CRITERION - LOG SC =               1.0129
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8223
 HANNAN AND QUINN (1979) CRITERION =               2.1259
 RICE (1984) CRITERION =                           1.8751
 SHIBATA (1981) CRITERION =                        1.7201
 SCHWARZ (1978) CRITERION - SC =                   2.7536
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.7810

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS          DF            MS                   F
REGRESSION        124.88         21.        5.9465                3.811
ERROR             204.39        131.        1.5602              P-VALUE
TOTAL             329.27        152.        2.1662                0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS          DF            MS                   F
REGRESSION        680.84         22.        30.947               19.835
ERROR             204.39        131.        1.5602              P-VALUE
TOTAL             885.23        153.        5.7858                0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     131 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.43166     0.1141      3.783     0.000 0.314     0.4103     0.5217
LBL      -0.10710     0.1316     -0.8140    0.417-0.071    -0.0682    -0.4688
LBD      -0.14766     0.5560     -0.2656    0.791-0.023    -0.0242    -0.1835
LCL      -0.45930E-01 0.8296E-01 -0.5537    0.581-0.048    -0.0485    -0.2057
LCW       0.21234     0.1326      1.602     0.112 0.139     0.1102     0.6200
LCD      -0.30599     0.4206     -0.7275    0.468-0.063    -0.0629    -0.4192
LQ       -0.28471E-01 0.9656E-01 -0.2948    0.769-0.026    -0.0282    -0.2431
LTF       0.46687E-01 0.7600E-01  0.6143    0.540 0.054     0.0558     0.6396
DPA       0.43172     0.4551      0.9486    0.345 0.083     0.1373     0.1539
DPCOR     0.47270     0.5905      0.8006    0.425 0.070     0.0929     0.0227
DPC       0.31341     0.4464      0.7021    0.484 0.061     0.0859     0.0333
DPGL     -0.35366E-01 0.3334     -0.1061    0.916-0.009    -0.0120    -0.0087
DPGS     -0.63428     0.4435      -1.430    0.155-0.124    -0.1778    -0.0718
DPGSL    -0.28083     0.3398     -0.8265    0.410-0.072    -0.0860    -0.0414
DPRAF    -0.11955     0.6279     -0.1904    0.849-0.017    -0.0201    -0.0041
DPRAU    -0.42104E-01 0.5773     -0.7294E-01 0.942-0.006   -0.0080    -0.0019
DPREA    -0.37252     0.5689     -0.6548    0.514-0.057    -0.0939    -0.0319
DPRNA    -0.85150E-01 0.6584     -0.1293    0.897-0.011    -0.0137    -0.0026
DPRNWE    0.95024     0.5335      1.781     0.077 0.154     0.2988     0.1531
DPRSA    -0.70429E-01 0.5570     -0.1264    0.900-0.011    -0.0172    -0.0056
DPRWAM   -0.72901     0.5405      -1.349    0.180-0.117    -0.1386    -0.0325
CONSTANT   1.0989      2.176      0.5049    0.614 0.044     0.0000     0.5765

DURBIN-WATSON = 1.2963    VON NEUMANN RATIO = 1.3048    RHO =  0.34695
RESIDUAL SUM = -0.25335E-12  RESIDUAL VARIANCE =   1.5602
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 SUM OF ABSOLUTE ERRORS=   140.64
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3793
 RUNS TEST:   49 RUNS,   78 POS,    0 ZERO,   75 NEG  NORMAL STATISTIC = -4.6204
 COEFFICIENT OF SKEWNESS =  -0.4162 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =   0.0410 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.3306 P-VALUE= 0.115

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  0.0  0.0  1.0  2.0  3.0  1.0  3.0  2.0  6.0  1.0  6.0 10.0 11.0 16.0 13.0 16.0
7.0  8.0 11.0 16.0
          10.0  4.0  4.0  0.0  0.0  2.0  0.0  0.0  0.0  0.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   34.1353 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_*model specification test
 |_diagnos / reset

 REQUIRED MEMORY IS PAR=      87 CURRENT PAR=  112400
 DEPENDENT VARIABLE = LTRFB          153 OBSERVATIONS
 REGRESSION COEFFICIENTS
   0.431657503657     -0.107096677017     -0.147655982611     -0.459303063663E-01
   0.212339616582     -0.305991385788     -0.284707451689E-01  0.466871076241E-01
   0.431721230177      0.472698992204      0.313408901762     -0.353660718208E-01
  -0.634280626346     -0.280826137745     -0.119550297484     -0.421044377488E-01
  -0.372522776855     -0.851503561598E-01  0.950242915944     -0.704286639674E-01
  -0.729012020965       1.09886820983

 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
   RESET(2)=   3.5602     - F WITH DF1=   1 AND DF2= 130 P-VALUE= 0.061
   RESET(3)=   9.0374     - F WITH DF1=   2 AND DF2= 129 P-VALUE= 0.000
   RESET(4)=   6.1414     - F WITH DF1=   3 AND DF2= 128 P-VALUE= 0.001

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETL
  FRESET(1)=   8.5697     - F WITH DF1=   2 AND DF2= 129 P-VALUE= 0.000
  FRESET(2)=   4.8375     - F WITH DF1=   4 AND DF2= 127 P-VALUE= 0.001
  FRESET(3)=   3.2032     - F WITH DF1=   6 AND DF2= 125 P-VALUE= 0.006

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETS
  FRESET(1)=  0.16080     - F WITH DF1=   2 AND DF2= 129 P-VALUE= 0.852
  FRESET(2)=  0.18850     - F WITH DF1=   4 AND DF2= 127 P-VALUE= 0.944
  FRESET(3)=  0.47088     - F WITH DF1=   6 AND DF2= 125 P-VALUE= 0.829

 |_OLS ltrfc ltrfb lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea
dprna dprnwe dprsa dprwam/ hetcov

 REQUIRED MEMORY IS PAR=      67 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.4208     R-SQUARE ADJUSTED =   0.3381
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.2956
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1383
 SUM OF SQUARED ERRORS-SSE=   172.32
 MEAN OF DEPENDENT VARIABLE =   2.3038
 LOG OF THE LIKELIHOOD FUNCTION = -226.195

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.4650
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.38036
  SCHWARZ (1978) CRITERION - LOG SC =             0.77649
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
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    GENERALIZED CROSS VALIDATION - GCV =          1.4905
 HANNAN AND QUINN (1979) CRITERION =              1.7182
 RICE (1984) CRITERION =                          1.5250
 SHIBATA (1981) CRITERION =                       1.4207
 SCHWARZ (1978) CRITERION - SC =                  2.1738
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.4628

                 ANALYSIS OF VARIANCE - FROM MEAN
                  SS          DF           MS               F
REGRESSION      125.21        19.        6.5898           5.086
ERROR           172.32        133.       1.2956          P-VALUE
TOTAL           297.53        152.       1.9574           0.000

                 ANALYSIS OF VARIANCE - FROM ZERO
                  SS          DF           MS               F
REGRESSION      937.25        20.        46.863          36.169
ERROR           172.32        133.       1.2956          P-VALUE
TOTAL           1109.6        153.       7.2521           0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO       PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     133 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      0.36590    0.1098       3.332     0.001 0.278      0.3849     0.3028
LCL        0.26034    0.6330E-01   4.113     0.000 0.336      0.2892     0.9647
LCW       -0.12037    0.1069      -1.126     0.262-0.097     -0.0657    -0.2908
LCD       -0.49740    0.3383      -1.470     0.144-0.126     -0.1076    -0.5639
LQ         0.70452E-01 0.7044E-01  1.000     0.319 0.086      0.0734     0.4978
LTF       -0.10562    0.5214E-01  -2.026     0.045-0.173     -0.1328    -1.1973
DPA        -1.0538    0.5351      -1.969     0.051-0.168     -0.3526    -0.3109
DPCOR      -1.0630    0.6405      -1.660     0.099-0.142     -0.2198    -0.0422
DPC       -0.58491    0.5148      -1.136     0.258-0.098     -0.1686    -0.0514
DPGL      -0.39874    0.3198      -1.247     0.215-0.107     -0.1427    -0.0814
DPGS       0.18237    0.3660      0.4983     0.619 0.043      0.0538     0.0171
DPGSL      0.14463    0.3199      0.4522     0.652 0.039      0.0466     0.0176
DPRAF     -0.42521    0.5876     -0.7237     0.471-0.063     -0.0754    -0.0121
DPRAU      0.57601    0.3674       1.568     0.119 0.135      0.1152     0.0212
DPREA     -0.35695    0.3785     -0.9431     0.347-0.082     -0.0946    -0.0253
DPRNA     -0.19964    0.4476     -0.4460     0.656-0.039     -0.0337    -0.0051
DPRNWE    -0.14589    0.3583     -0.4072     0.685-0.035     -0.0483    -0.0195
DPRSA      0.38344    0.3409       1.125     0.263 0.097      0.0983     0.0250
DPRWAM     0.24791    0.4022      0.6164     0.539 0.053      0.0496     0.0091
CONSTANT   4.0191      1.769       2.271     0.025 0.193      0.0000     1.7445

DURBIN-WATSON = 1.4702    VON NEUMANN RATIO = 1.4798    RHO =  0.26139
RESIDUAL SUM =  0.33662E-12  RESIDUAL VARIANCE =   1.2956
SUM OF ABSOLUTE ERRORS=   127.69
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4208
RUNS TEST:   67 RUNS,   83 POS,    0 ZERO,   70 NEG  NORMAL STATISTIC = -1.6256
COEFFICIENT OF SKEWNESS =  -0.4168 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.5589 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    5.9484 P-VALUE= 0.051

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  1.0  1.0  0.0  0.0  1.0  1.0  5.0  5.0  1.0  4.0 10.0  8.0 13.0 11.0  9.0 15.0
16.0 15.0  6.0  9.0
           9.0  4.0  3.0  2.0  4.0  0.0  0.0  0.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   25.1405 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.001
 |_*model specification test
 |_diagnos / reset

REQUIRED MEMORY IS PAR=      83 CURRENT PAR=  112400
DEPENDENT VARIABLE = LTRFC          153 OBSERVATIONS
REGRESSION COEFFICIENTS
  0.365897262336      0.260342809221     -0.120369560416     -0.497396885957
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  0.704515505866E-01 -0.105618693119      -1.05380648826      -1.06298598943
 -0.584914071865     -0.398739733943      0.182372106650      0.144634403645
 -0.425210161735      0.576007984842     -0.356947445750     -0.199642312777
 -0.145892103852      0.383438922510      0.247908965004       4.01907483636


 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
   RESET(2)=   6.7693     - F WITH DF1=   1 AND DF2= 132 P-VALUE= 0.010
   RESET(3)=   4.2009     - F WITH DF1=   2 AND DF2= 131 P-VALUE= 0.017
   RESET(4)=   4.9849     - F WITH DF1=   3 AND DF2= 130 P-VALUE= 0.003

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETL
  FRESET(1)=   1.8299     - F WITH DF1=   2 AND DF2= 131 P-VALUE= 0.165
  FRESET(2)=   3.8509     - F WITH DF1=   4 AND DF2= 129 P-VALUE= 0.005
  FRESET(3)=   3.6612     - F WITH DF1=   6 AND DF2= 127 P-VALUE= 0.002

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETS
  FRESET(1)=   1.3039     - F WITH DF1=   2 AND DF2= 131 P-VALUE= 0.275
  FRESET(2)=   1.7407     - F WITH DF1=   4 AND DF2= 129 P-VALUE= 0.145
  FRESET(3)=   1.4546     - F WITH DF1=   6 AND DF2= 127 P-VALUE= 0.199

 |_OLS ltrfb ltrfc lbl lbd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna
dprnwe dprsa dprwam/ hetcov

 REQUIRED MEMORY IS PAR=      66 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS      DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.3707     R-SQUARE ADJUSTED =   0.2862
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.5463
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2435
 SUM OF SQUARED ERRORS-SSE=   207.20
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION = -240.297

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.7383
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.55163
  SCHWARZ (1978) CRITERION - LOG SC =              0.92795
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           1.7655
  HANNAN AND QUINN (1979) CRITERION =               2.0228
  RICE (1984) CRITERION =                           1.8018
  SHIBATA (1981) CRITERION =                        1.6906
  SCHWARZ (1978) CRITERION - SC =                   2.5293
  AKAIKE (1974) INFORMATION CRITERION - AIC =       1.7361

                      ANALYSIS OF VARIANCE - FROM MEAN
                         SS          DF            MS                  F
 REGRESSION        122.06          18.         6.7813                4.386
 ERROR             207.20         134.         1.5463              P-VALUE
 TOTAL             329.27         152.         2.1662                0.000

                      ANALYSIS OF VARIANCE - FROM ZERO
                         SS          DF            MS                  F
 REGRESSION        678.02          19.         35.685               23.078
 ERROR             207.20         134.         1.5463              P-VALUE
 TOTAL             885.23         153.         5.7858                0.000


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR     134 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC     0.41910     0.1015       4.130     0.000 0.336     0.3984     0.5065
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LBL      -0.55987E-01 0.1334     -0.4198     0.675-0.036    -0.0356    -0.2451
LBD      -0.57510E-01 0.5484     -0.1049     0.917-0.009    -0.0094    -0.0715
LQ       -0.84293E-01 0.8835E-01 -0.9541     0.342-0.082    -0.0835    -0.7198
LTF       0.45829E-01 0.7492E-01  0.6117     0.542 0.053     0.0548     0.6279
DPA       0.43180     0.4644      0.9298     0.354 0.080     0.1373     0.1540
DPCOR     0.45091     0.6027      0.7481     0.456 0.064     0.0886     0.0216
DPC       0.41291     0.4604      0.8969     0.371 0.077     0.1131     0.0439
DPGL      0.18579E-01 0.3267      0.5687E-01 0.955 0.005     0.0063     0.0046
DPGS     -0.55033     0.4416     -1.246      0.215-0.107    -0.1543    -0.0623
DPGSL    -0.22047     0.3357     -0.6567     0.512-0.057    -0.0676    -0.0325
DPRAF    -0.78970E-01 0.6311     -0.1251     0.901-0.011    -0.0133    -0.0027
DPRAU     0.11551E-02 0.5707      0.2024E-02 0.998 0.000     0.0002     0.0001
DPREA    -0.30343     0.5580     -0.5438     0.588-0.047    -0.0765    -0.0260
DPRNA     0.32293E-01 0.6239      0.5176E-01 0.959 0.004     0.0052     0.0010
DPRNWE    0.99201     0.5240      1.893      0.061 0.161     0.3120     0.1599
DPRSA     0.25459E-01 0.5360      0.4749E-01 0.962 0.004     0.0062     0.0020
DPRWAM   -0.69380     0.5309     -1.307      0.194-0.112    -0.1319    -0.0309
CONSTANT   1.2761      1.945      0.6560     0.513 0.057     0.0000     0.6694

DURBIN-WATSON = 1.3017    VON NEUMANN RATIO = 1.3102    RHO =  0.34416
RESIDUAL SUM = -0.25713E-12  RESIDUAL VARIANCE =   1.5463
SUM OF ABSOLUTE ERRORS=   141.88
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3707
RUNS TEST:   49 RUNS,   75 POS,     0 ZERO,    78 NEG  NORMAL STATISTIC = -4.6204
COEFFICIENT OF SKEWNESS =  -0.4179 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0006 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    4.3765 P-VALUE= 0.112

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
OBSERVED  0.0  0.0  1.0  3.0  2.0  1.0  4.0  2.0  4.0  2.0  5.0 13.0 10.0 14.0 17.0 14.0
6.0  7.0  7.0 20.0
         11.0  4.0  4.0  0.0  1.0  0.0  1.0  0.0  0.0  0.0
EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
          6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
CHI-SQUARE =   48.4664 WITH  9 DEGREES OF FREEDOM, P-VALUE= 0.000
|_*model specification test
|_diagnos / reset

REQUIRED MEMORY IS PAR=      81 CURRENT PAR=  112400
DEPENDENT VARIABLE = LTRFB           153 OBSERVATIONS
REGRESSION COEFFICIENTS
  0.419098563940     -0.559870487807E-01 -0.575102147394E-01 -0.842934576060E-01
  0.458286802041E-01  0.431795888310      0.450906278903      0.412914188709
  0.185785338344E-01 -0.550332961063     -0.220470817690     -0.789696027432E-01
  0.115513276429E-02 -0.303426644203      0.322926250165E-01  0.992005691579
  0.254585974218E-01 -0.693795356177      1.27609740106

RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
  RESET(2)=    4.6340     - F WITH DF1=   1 AND DF2= 133 P-VALUE= 0.033
  RESET(3)=    8.7155     - F WITH DF1=   2 AND DF2= 132 P-VALUE= 0.000
  RESET(4)=    5.9190     - F WITH DF1=   3 AND DF2= 131 P-VALUE= 0.001

DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETL
 FRESET(1)=   8.5882      - F WITH DF1=   2 AND DF2= 132 P-VALUE= 0.000
 FRESET(2)=   4.7001      - F WITH DF1=   4 AND DF2= 130 P-VALUE= 0.001
 FRESET(3)=   3.2669      - F WITH DF1=   6 AND DF2= 128 P-VALUE= 0.005

DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETS
 FRESET(1)=  0.53265      - F WITH DF1=   2 AND DF2= 132 P-VALUE= 0.588
 FRESET(2)=  0.29141      - F WITH DF1=   4 AND DF2= 130 P-VALUE= 0.883
 FRESET(3)=  0.63231      - F WITH DF1=   6 AND DF2= 128 P-VALUE= 0.704
|_************************************2sls for trfc
|_**Hausman Specification test for errors in variables-Simultaneity check
|_* Estimation using the consistent estimator (IV) under both
|_* the null and the alternative hypotheses;
|_* in SHAZAM, the 2SLS command is used for instrumental variable estimation
```

```
|_sample 1 153
|_**Instrumental varaible is berth depth, assuming it has an impact on channel dues
through berth occupancy charge

|_2SLS ltrfc ltrfb (lbd ) / DN COEF=B1C PCOV COV=V1C
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
  1 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.1515     R-SQUARE ADJUSTED =   0.1459
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6500
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2845
SUM OF SQUARED ERRORS-SSE=   252.44
MEAN OF DEPENDENT VARIABLE =   2.3038


                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.44852     0.4429       1.013     0.311 0.082      0.4718     0.3711
CONSTANT   1.4488     0.8507       1.703     0.089 0.137      0.0000     0.6289

VARIANCE-COVARIANCE MATRIX OF COEFFICIENTS
LTRFB     0.19618
CONSTANT -0.37396      0.72364
             LTRFB        CONSTANT
|_GEN1 SIGIVC=$SIG2
...NOTE..CURRENT VALUE OF $SIG2=   1.6500
|_* Estimation using the efficient estimator (OLS) under the null

|_OLS ltrfc ltrfb / DN COEF=B0C COV=V0C NOMULSIGSQ

REQUIRED MEMORY IS PAR=      44 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

 R-SQUARE =   0.1572     R-SQUARE ADJUSTED =   0.1516
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6389
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2802
SUM OF SQUARED ERRORS-SSE=   250.75
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION = -254.891

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.6603
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.52018
 SCHWARZ (1978) CRITERION - LOG SC =              0.55979
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.6826
 HANNAN AND QUINN (1979) CRITERION =               1.7096
 RICE (1984) CRITERION =                           1.6829
 SHIBATA (1981) CRITERION =                        1.6818
 SCHWARZ (1978) CRITERION - SC =                   1.7503
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.6823

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS         DF            MS                F
REGRESSION        46.773         1.         46.773             28.539
ERROR             250.75       153.         1.6389            P-VALUE
TOTAL             297.53       152.         1.9574              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS         DF            MS                F
```

```
 REGRESSION       858.82          2.        429.41               262.008
 ERROR            250.75        153.        1.6389               P-VALUE
 TOTAL            1109.6        153.        7.2521                 0.000


                               ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFB     0.37690     0.5511E-01   6.839     0.000 0.486     0.3965     0.3119
 CONSTANT   1.5853     0.1326       11.96     0.000 0.697     0.0000     0.6881

 DURBIN-WATSON = 1.1079    VON NEUMANN RATIO = 1.1151    RHO =  0.44600
 RESIDUAL SUM =  0.25713E-12  RESIDUAL VARIANCE =   1.6389
 SUM OF ABSOLUTE ERRORS=   159.07
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
 RUNS TEST:   48 RUNS,   82 POS,     0 ZERO,    71 NEG  NORMAL STATISTIC = -4.7462
 COEFFICIENT OF SKEWNESS =  -0.6470 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =  -0.1171 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   10.6126 P-VALUE= 0.005

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
 OBSERVED  1.0  0.0 11.0  0.0 16.0  7.0 26.0 18.0 24.0 27.0 17.0  5.0  1.0  0.0  0.0
 EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
 CHI-SQUARE =   47.2356 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_* Use the error variance estimate obtained from IV estimation.
 |_MATRIX V0C=SIGIVC*V0C
 |_PRINT V0C
 V0C
     2 BY      2 MATRIX
   0.5011029E-02 -0.9552200E-02
  -0.9552200E-02  0.2899278E-01
 |_* Compute the Hausman specification test statistic using the method
 |_* illustrated in Griffiths, Hill and Judge (1993, p. 465)
 |_SAMPLE 1 2
 |_GENR QC=B1C-B0C
 |_MATRIX VQC=V1C-V0C
 |_MATRIX MC=(QC(1)**2) / VQC(1,1)
 |_* The statistic M is distributed chi-square with 1 degree of freedom
 |_* under the null hypothesis. The 5% critical value is 3.84.
 |_PRINT MC
 MC
   0.2683648E-01
 |_**As M statistics, which Hausmand Speci test statistics is significant at 5% (M<3.84),
we reject null hypothesis that there are
 |  no errors in
 |_end
 |_**Instrumental varaible is berth length, assuming it has an impact on channel dues
through berth occupancy charge
 |_sample 1 153

 |_2SLS ltrfc ltrfb (lbl) / DN COEF=B1C1 PCOV COV=V1C1
  TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
   1 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
       153 OBSERVATIONS
 DN OPTION IN EFFECT - DIVISOR IS N

  R-SQUARE =  -1.3889     R-SQUARE ADJUSTED =  -1.4047
 VARIANCE OF THE ESTIMATE-SIGMA**2 =    4.6455
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   2.1553
 SUM OF SQUARED ERRORS-SSE=   710.76
 MEAN OF DEPENDENT VARIABLE =   2.3038


                               ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
```

```
LTRFB      1.5589      1.441       1.082     0.279 0.088     1.6399     1.2899
CONSTANT -0.66776      2.752     -0.2427     0.808-0.020     0.0000    -0.2899

VARIANCE-COVARIANCE MATRIX OF COEFFICIENTS
LTRFB      2.0757
CONSTANT  -3.9568       7.5729
             LTRFB        CONSTANT
|_GEN1 SIGIVC1=$SIG2
...NOTE..CURRENT VALUE OF $SIG2=   4.6455
|_* Estimation using the efficient estimator (OLS) under the null

|_OLS ltrfc ltrfb / DN COEF=B0C1 COV=V0C1 NOMULSIGSQ

REQUIRED MEMORY IS PAR=      44 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

 R-SQUARE =   0.1572     R-SQUARE ADJUSTED =   0.1516
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6389
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2802
SUM OF SQUARED ERRORS-SSE=   250.75
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION = -254.891

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.6603
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.52018
 SCHWARZ (1978) CRITERION - LOG SC =             0.55979
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          1.6826
 HANNAN AND QUINN (1979) CRITERION =              1.7096
 RICE (1984) CRITERION =                          1.6829
 SHIBATA (1981) CRITERION =                       1.6818
 SCHWARZ (1978) CRITERION - SC =                  1.7503
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.6823

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF             MS                 F
REGRESSION        46.773          1.         46.773              28.539
ERROR             250.75        153.         1.6389             P-VALUE
TOTAL             297.53        152.         1.9574               0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF             MS                 F
REGRESSION        858.82          2.         429.41             262.008
ERROR             250.75        153.         1.6389             P-VALUE
TOTAL             1109.6        153.         7.2521               0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.37690     0.5511E-01   6.839     0.000 0.486     0.3965     0.3119
CONSTANT   1.5853     0.1326       11.96     0.000 0.697     0.0000     0.6881

DURBIN-WATSON = 1.1079    VON NEUMANN RATIO = 1.1151    RHO =  0.44600
RESIDUAL SUM =  0.25713E-12  RESIDUAL VARIANCE =   1.6389
SUM OF ABSOLUTE ERRORS=   159.07
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
RUNS TEST:   48 RUNS,   82 POS,    0 ZERO,   71 NEG  NORMAL STATISTIC = -4.7462
COEFFICIENT OF SKEWNESS =  -0.6470 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.1171 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   10.6126 P-VALUE= 0.005
```

```
     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  0.0 11.0  0.0 16.0  7.0 26.0 18.0 24.0 27.0 17.0  5.0  1.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   47.2356 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.000
|_* Use the error variance estimate obtained from IV estimation.
|_MATRIX V0C1=SIGIVC1*V0C1
|_PRINT V0C1
V0C1
    2 BY     2 MATRIX
  0.1410855E-01 -0.2689422E-01
 -0.2689422E-01  0.8162919E-01
|_* Compute the Hausman specification test statistic using the method
|_* illustrated in Griffiths, Hill and Judge (1993, p. 465)
|_SAMPLE 1 2
|_GENR QC1=B1C1-B0C1
|_MATRIX VQC1=V1C1-V0C1
|_MATRIX MC1=(QC1(1)**2) / VQC1(1,1)
|_* The statistic M is distributed chi-square with 1 degree of freedom
|_* under the null hypothesis. The 5% critical value is 3.84.
|_PRINT MC1
MC1
  0.6776582
|_end
|_**Instrumental varaible is berth length and berth depth, assuming it has an impact on
channel dues through berth occupancy char
| ge
|_sample 1 153

|_2SLS ltrfc ltrfb (lbl lbd ) / DN COEF=B1C1 PCOV COV=V1C1
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
  2 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =    0.0950     R-SQUARE ADJUSTED =    0.0890
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.7598
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.3266
SUM OF SQUARED ERRORS-SSE=   269.25
MEAN OF DEPENDENT VARIABLE =   2.3038


                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.61393     0.4370       1.405     0.160 0.114      0.6458     0.5080
CONSTANT   1.1335     0.8400       1.349     0.177 0.109      0.0000     0.4920

VARIANCE-COVARIANCE MATRIX OF COEFFICIENTS
LTRFB     0.19100
CONSTANT -0.36409      0.70554
             LTRFB        CONSTANT
|_GEN1 SIGIVC1=$SIG2
...NOTE..CURRENT VALUE OF $SIG2=   1.7598
|_* Estimation using the efficient estimator (OLS) under the null

|_OLS ltrfc ltrfb / DN COEF=B0C1 COV=V0C1 NOMULSIGSQ

REQUIRED MEMORY IS PAR=      44 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

 R-SQUARE =    0.1572     R-SQUARE ADJUSTED =    0.1516
VARIANCE OF THE ESTIMATE-SIGMA**2 =    1.6389
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.2802
SUM OF SQUARED ERRORS-SSE=   250.75
MEAN OF DEPENDENT VARIABLE =   2.3038
```

```
LOG OF THE LIKELIHOOD FUNCTION = -254.891

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.6603
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.52018
 SCHWARZ (1978) CRITERION - LOG SC =              0.55979
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =            1.6826
 HANNAN AND QUINN (1979) CRITERION =                1.7096
 RICE (1984) CRITERION =                            1.6829
 SHIBATA (1981) CRITERION =                         1.6818
 SCHWARZ (1978) CRITERION - SC =                    1.7503
 AKAIKE (1974) INFORMATION CRITERION - AIC =        1.6823

                    ANALYSIS OF VARIANCE - FROM MEAN
                     SS           DF            MS                 F
REGRESSION        46.773          1.         46.773             28.539
ERROR             250.75        153.         1.6389            P-VALUE
TOTAL             297.53        152.         1.9574              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                     SS           DF            MS                 F
REGRESSION        858.82          2.         429.41            262.008
ERROR             250.75        153.         1.6389            P-VALUE
TOTAL             1109.6        153.         7.2521              0.000


                            ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.37690    0.5511E-01   6.839      0.000 0.486     0.3965     0.3119
CONSTANT   1.5853     0.1326       11.96      0.000 0.697     0.0000     0.6881

DURBIN-WATSON = 1.1079    VON NEUMANN RATIO = 1.1151    RHO =  0.44600
RESIDUAL SUM =  0.25713E-12  RESIDUAL VARIANCE =   1.6389
SUM OF ABSOLUTE ERRORS=   159.07
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
RUNS TEST:   48 RUNS,   82 POS,    0 ZERO,    71 NEG  NORMAL STATISTIC = -4.7462
COEFFICIENT OF SKEWNESS =  -0.6470 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.1171 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   10.6126 P-VALUE= 0.005

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  0.0 11.0  0.0 16.0  7.0 26.0 18.0 24.0 27.0 17.0  5.0  1.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   47.2356 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.000
|_* Use the error variance estimate obtained from IV estimation.
|_MATRIX V0C1=SIGIVC1*V0C1
|_PRINT V0C1
V0C1
    2 BY     2 MATRIX
  0.5344720E-02 -0.1018829E-01
 -0.1018829E-01  0.3092345E-01
|_* Compute the Hausman specification test statistic using the method
|_* illustrated in Griffiths, Hill and Judge (1993, p. 465)
|_SAMPLE 1 2
|_GENR QC1=B1C1-B0C1
|_MATRIX VQC1=V1C1-V0C1
|_MATRIX MC1=(QC1(1)**2) / VQC1(1,1)
|_* The statistic M is distributed chi-square with 1 degree of freedom
|_* under the null hypothesis. The 5% critical value is 3.84.
|_PRINT MC1
MC1
  0.3026330
|_**Instrumental varaible is berth length, assuming it has an impact on berth occupancy
```

```
charge through channel due
 |_sample 1 153

 |_2SLS ltrfb ltrfc (lbl) / DN COEF=B3 PCOV COV=V3
  TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
   1 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
       153 OBSERVATIONS
 DN OPTION IN EFFECT - DIVISOR IS N

  R-SQUARE =   0.1117     R-SQUARE ADJUSTED =   0.1058
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.9117
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3826
 SUM OF SQUARED ERRORS-SSE=   292.48
 MEAN OF DEPENDENT VARIABLE =   1.9062


                             ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC     0.64149     0.5929       1.082     0.279 0.088      0.6098     0.7753
 CONSTANT  0.42837      1.370      0.3126     0.755 0.025      0.0000     0.2247

 VARIANCE-COVARIANCE MATRIX OF COEFFICIENTS
 LTRFC     0.35150
 CONSTANT -0.80979       1.8781
              LTRFC        CONSTANT
 |_GEN1 SIGIVB=$SIG2
 ...NOTE..CURRENT VALUE OF $SIG2=   1.9117

 |_OLS ltrfb ltrfc / DN COEF=B2 COV=V2 NOMULSIGSQ

 REQUIRED MEMORY IS PAR=      44 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

  R-SQUARE =   0.1572     R-SQUARE ADJUSTED =   0.1516
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.8137
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3468
 SUM OF SQUARED ERRORS-SSE=   277.50
 MEAN OF DEPENDENT VARIABLE =   1.9062
 LOG OF THE LIKELIHOOD FUNCTION = -262.645

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.8375
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.62154
  SCHWARZ (1978) CRITERION - LOG SC =              0.66115
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           1.8621
  HANNAN AND QUINN (1979) CRITERION =               1.8920
  RICE (1984) CRITERION =                           1.8624
  SHIBATA (1981) CRITERION =                        1.8612
  SCHWARZ (1978) CRITERION - SC =                   1.9370
  AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8618

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS         DF             MS                  F
 REGRESSION        51.762         1.          51.762              28.539
 ERROR             277.50       153.          1.8137             P-VALUE
 TOTAL             329.27       152.          2.1662               0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS         DF             MS                  F
 REGRESSION        607.72         2.          303.86             167.532
 ERROR             277.50       153.          1.8137             P-VALUE
```

```
TOTAL             885.23        153.        5.7858                 0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.41710     0.5797E-01   7.195      0.000 0.505      0.3965     0.5041
CONSTANT  0.94532     0.1561       6.055      0.000 0.442      0.0000     0.4959

DURBIN-WATSON = 1.0529    VON NEUMANN RATIO = 1.0599    RHO =  0.47331
RESIDUAL SUM = -0.88374E-13  RESIDUAL VARIANCE =   1.8137
SUM OF ABSOLUTE ERRORS=   162.80
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
RUNS TEST:   50 RUNS,   77 POS,    0 ZERO,   76 NEG  NORMAL STATISTIC = -4.4608
COEFFICIENT OF SKEWNESS =  -0.2030 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0247 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    1.0553 P-VALUE= 0.590

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  3.0  3.0  7.0  8.0 16.0 26.0 26.0 20.0 20.0  8.0 12.0  3.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   11.9513 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.367
|_* Use the error variance estimate obtained from IV estimation.
|_MATRIX V2=SIGIVB*V2
|_PRINT V2
V2
    2 BY     2 MATRIX
  0.6425170E-02 -0.1480231E-01
 -0.1480231E-01  0.4659609E-01
|_* Compute the Hausman specification test statistic using the method
|_* illustrated in Griffiths, Hill and Judge (1993, p. 465)
|_SAMPLE 1 2
|_GENR QB=B3-B2
|_MATRIX VQB=V3-V2
|_MATRIX MB=(QB(1)**2) / VQB(1,1)
|_* The statistic M is distributed chi-square with 1 degree of freedom
|_* under the null hypothesis. The 5% critical value is 3.84.
|_PRINT MB
MB
  0.1459120
|_**Instrumental varaible is berth depth, assuming it has an impact on berth occupancy
charge through channel due
|_sample 1 153

|_2SLS ltrfb ltrfc (lbd) / DN COEF=B3B1 PCOV COV=V3B1
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
  1 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =  -2.8111      R-SQUARE ADJUSTED =  -2.8363
VARIANCE OF THE ESTIMATE-SIGMA**2 =    8.2017
STANDARD ERROR OF THE ESTIMATE-SIGMA =    2.8639
SUM OF SQUARED ERRORS-SSE=   1254.9
MEAN OF DEPENDENT VARIABLE =    1.9062


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      2.2295       2.202       1.013     0.311 0.082      2.1194     2.6945
CONSTANT  -3.2302       5.078     -0.6362     0.525-0.052      0.0000    -1.6945

VARIANCE-COVARIANCE MATRIX OF COEFFICIENTS
LTRFC      4.8474
CONSTANT  -11.168       25.781
```

```
             LTRFC         CONSTANT
|_GEN1 SIGIVB1=$SIG2
...NOTE..CURRENT VALUE OF $SIG2=   8.2017

|_OLS ltrfb ltrfc / DN COEF=B2B1 COV=V2B1 NOMULSIGSQ

REQUIRED MEMORY IS PAR=      45 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

 R-SQUARE =   0.1572     R-SQUARE ADJUSTED =   0.1516
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.8137
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3468
SUM OF SQUARED ERRORS-SSE=   277.50
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION = -262.645

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.8375
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.62154
 SCHWARZ (1978) CRITERION - LOG SC =              0.66115
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8621
 HANNAN AND QUINN (1979) CRITERION =               1.8920
 RICE (1984) CRITERION =                           1.8624
 SHIBATA (1981) CRITERION =                        1.8612
 SCHWARZ (1978) CRITERION - SC =                   1.9370
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8618

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS           DF           MS                 F
REGRESSION        51.762           1.         51.762             28.539
ERROR             277.50         153.         1.8137            P-VALUE
TOTAL             329.27         152.         2.1662              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS           DF           MS                 F
REGRESSION        607.72           2.         303.86            167.532
ERROR             277.50         153.         1.8137            P-VALUE
TOTAL             885.23         153.         5.7858              0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.41710     0.5797E-01   7.195     0.000 0.505     0.3965     0.5041
CONSTANT  0.94532     0.1561       6.055     0.000 0.442     0.0000     0.4959

DURBIN-WATSON = 1.0529    VON NEUMANN RATIO = 1.0599    RHO =  0.47331
RESIDUAL SUM = -0.88374E-13  RESIDUAL VARIANCE =   1.8137
SUM OF ABSOLUTE ERRORS=   162.80
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
RUNS TEST:   50 RUNS,   77 POS,    0 ZERO,   76 NEG  NORMAL STATISTIC = -4.4608
COEFFICIENT OF SKEWNESS =  -0.2030 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0247 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    1.0553 P-VALUE= 0.590

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  3.0  3.0  7.0  8.0 16.0 26.0 26.0 20.0 20.0  8.0 12.0  3.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =    11.9513 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.367
|_* Use the error variance estimate obtained from IV estimation.
|_MATRIX V2B1=SIGIVB1*V2B1
|_PRINT V2B1
```

```
V2B1
    2 BY     2 MATRIX
  0.2756632E-01 -0.6350730E-01
 -0.6350730E-01  0.1999142
 |_* Compute the Hausman specification test statistic using the method
 |_* illustrated in Griffiths, Hill and Judge (1993, p. 465)
 |_SAMPLE 1 2
 |_GENR QB1=B3B1-B2B1
 |_MATRIX VQB1=V3B1-V2B1
 |_MATRIX MB1=(QB1(1)**2) / VQB1(1,1)
 |_* The statistic M is distributed chi-square with 1 degree of freedom
 |_* under the null hypothesis. The 5% critical value is 3.84.
 |_PRINT MB1
MB1
  0.6815441
 |_**Instrumental varaible is berth lenght, depth, assuming it has an impact on berth
occupancy charge through channel due
 |_sample 1 153

 |_2SLS ltrfb ltrfc (lbl lbd) / DN COEF=B3 PCOV COV=V3
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
  2 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =  -0.0763     R-SQUARE ADJUSTED =  -0.0834
VARIANCE OF THE ESTIMATE-SIGMA**2 =   2.3163
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.5219
SUM OF SQUARED ERRORS-SSE=   354.39
MEAN OF DEPENDENT VARIABLE =   1.9062


                              ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.92546     0.6156       1.503     0.133 0.121      0.8797     1.1185
CONSTANT -0.22585      1.424     -0.1587     0.874-0.013      0.0000    -0.1185

VARIANCE-COVARIANCE MATRIX OF COEFFICIENTS
LTRFC     0.37896
CONSTANT -0.87305       2.0265
            LTRFC        CONSTANT
 |_GEN1 SIGIVB=$SIG2
...NOTE..CURRENT VALUE OF $SIG2=   2.3163

 |_OLS ltrfb ltrfc / DN COEF=B2 COV=V2 NOMULSIGSQ

REQUIRED MEMORY IS PAR=      45 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

 R-SQUARE =   0.1572     R-SQUARE ADJUSTED =   0.1516
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.8137
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3468
SUM OF SQUARED ERRORS-SSE=   277.50
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION = -262.645

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.8375
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.62154
 SCHWARZ (1978) CRITERION - LOG SC =              0.66115
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8621
```

```
 HANNAN AND QUINN (1979) CRITERION =              1.8920
 RICE (1984) CRITERION =                          1.8624
 SHIBATA (1981) CRITERION =                       1.8612
 SCHWARZ (1978) CRITERION - SC =                  1.9370
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.8618

                     ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF             MS                 F
REGRESSION        51.762           1.        51.762              28.539
ERROR             277.50         153.        1.8137             P-VALUE
TOTAL             329.27         152.        2.1662               0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                       SS          DF             MS                 F
REGRESSION        607.72           2.        303.86             167.532
ERROR             277.50         153.        1.8137             P-VALUE
TOTAL             885.23         153.        5.7858               0.000


                             ASYMPTOTIC
VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR   --------    P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.41710     0.5797E-01   7.195     0.000 0.505     0.3965     0.5041
CONSTANT  0.94532     0.1561       6.055     0.000 0.442     0.0000     0.4959

DURBIN-WATSON = 1.0529    VON NEUMANN RATIO = 1.0599    RHO =  0.47331
RESIDUAL SUM = -0.88374E-13  RESIDUAL VARIANCE =   1.8137
SUM OF ABSOLUTE ERRORS=   162.80
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1572
RUNS TEST:   50 RUNS,    77 POS,     0 ZERO,    76 NEG  NORMAL STATISTIC = -4.4608
COEFFICIENT OF SKEWNESS =  -0.2030 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0247 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    1.0553 P-VALUE= 0.590

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  3.0  3.0  7.0  8.0 16.0 26.0 26.0 20.0 20.0  8.0 12.0  3.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   11.9513 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.367
|_* Use the error variance estimate obtained from IV estimation.
|_MATRIX V2=SIGIVB*V2
|_PRINT V2
V2
    2 BY     2 MATRIX
  0.7785171E-02 -0.1793548E-01
 -0.1793548E-01  0.5645897E-01
|_* Compute the Hausman specification test statistic using the method
|_* illustrated in Griffiths, Hill and Judge (1993, p. 465)
|_SAMPLE 1 2
|_GENR QB=B3-B2
|_MATRIX VQB=V3-V2
|_MATRIX MB=(QB(1)**2) / VQB(1,1)
|_* The statistic M is distributed chi-square with 1 degree of freedom
|_* under the null hypothesis. The 5% critical value is 3.84.
|_PRINT MB
MB
  0.6962522
|_******testing for endogeniety of ltrfb
|_sample 1 153

|_OLS ltrfb lbl lbd lq ltf / hetcov  resid=V2

REQUIRED MEMORY IS PAR=       50 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX
```

```
 R-SQUARE =   0.0551     R-SQUARE ADJUSTED =   0.0296
VARIANCE OF THE ESTIMATE-SIGMA**2 =   2.1021
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.4499
SUM OF SQUARED ERRORS-SSE=   311.11
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION = -271.391

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      2.1708
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.77508
 SCHWARZ (1978) CRITERION - LOG SC =             0.87412
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          2.1731
 HANNAN AND QUINN (1979) CRITERION =              2.2599
 RICE (1984) CRITERION =                          2.1756
 SHIBATA (1981) CRITERION =                       2.1663
 SCHWARZ (1978) CRITERION - SC =                  2.3968
 AKAIKE (1974) INFORMATION CRITERION - AIC =      2.1708

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                  F
REGRESSION         18.151         4.          4.5377              2.159
ERROR              311.11       148.          2.1021             P-VALUE
TOTAL              329.27       152.          2.1662              0.076

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                  F
REGRESSION         574.11         5.          114.82             54.622
ERROR              311.11       148.          2.1021             P-VALUE
TOTAL              885.23       153.          5.7858              0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     148 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LBL      -0.13239     0.1552     -0.8532    0.395-0.070    -0.0843    -0.5795
LBD      -0.93287     0.5163     -1.807     0.073-0.147    -0.1529    -1.1595
LQ       -0.44718E-01 0.9165E-01 -0.4879    0.626-0.040    -0.0443    -0.3819
LTF       0.14563     0.8010E-01  1.818     0.071 0.148     0.1740     1.9952
CONSTANT   2.1458      1.977      1.085     0.279 0.089     0.0000     1.1257

DURBIN-WATSON = 1.1349    VON NEUMANN RATIO = 1.1423    RHO =  0.42749
RESIDUAL SUM =  0.22826E-12  RESIDUAL VARIANCE =   2.1021
SUM OF ABSOLUTE ERRORS=   163.95
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0551
RUNS TEST:   52 RUNS,   71 POS,    0 ZERO,   82 NEG  NORMAL STATISTIC = -4.0939
COEFFICIENT OF SKEWNESS =  -0.6625 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   1.7947 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   29.3456 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  1.0  7.0  4.0  6.0 14.0 23.0 35.0 21.0 20.0  9.0  7.0  5.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   17.8491 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.022
 |_*using F test testing lbl and lbd correlate with ltrfb: coefficent of lbl lbd setting
equal to 0: require higher F value and si
 | gnificant at 1% or 5%. &
 |_*
 |_TEST lbl=0
TEST VALUE = -0.13239     STD. ERROR OF TEST VALUE  0.15518
T STATISTIC = -0.85315125     WITH  148 D.F.    P-VALUE= 0.39495
F STATISTIC =  0.72786706     WITH    1 AND  148 D.F.  P-VALUE= 0.39495
WALD CHI-SQUARE STATISTIC =  0.72786706     WITH    1 D.F.  P-VALUE= 0.39358
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 1.00000
 |_TEST lbd=0
```

```
TEST VALUE = -0.93287     STD. ERROR OF TEST VALUE  0.51628
T STATISTIC =  -1.8069215     WITH  148 D.F.     P-VALUE= 0.07281
F STATISTIC =   3.2649652     WITH    1 AND  148 D.F.  P-VALUE= 0.07281
WALD CHI-SQUARE STATISTIC =   3.2649652     WITH    1 D.F.  P-VALUE= 0.07077
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.30628
|_end
|_* Result: lbl is correlated with ltrfb at 5% significant level
|_sample 1 153

|_OLS ltrfc ltrfb lbd lcl lcw lcd lq ltf V2/ hetcov

REQUIRED MEMORY IS PAR=      55 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.2989     R-SQUARE ADJUSTED =   0.2599
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.4487
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2036
SUM OF SQUARED ERRORS-SSE=   208.61
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION = -240.814

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.5339
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.42767
 SCHWARZ (1978) CRITERION - LOG SC =             0.60593
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          1.5392
 HANNAN AND QUINN (1979) CRITERION =              1.6489
 RICE (1984) CRITERION =                          1.5452
 SHIBATA (1981) CRITERION =                       1.5239
 SCHWARZ (1978) CRITERION - SC =                  1.8330
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.5337

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                F
REGRESSION         88.919          8.         11.115             7.672
ERROR              208.61        144.         1.4487           P-VALUE
TOTAL              297.53        152.         1.9574             0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                F
REGRESSION         900.97          9.         100.11            69.103
ERROR              208.61        144.         1.4487           P-VALUE
TOTAL              1109.6        153.         7.2521             0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     144 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB      2.2138      0.8506      2.603     0.010 0.212     2.3289      1.8318
LBD        1.8676      0.8662      2.156     0.033 0.177     0.3221      1.9207
LCL       0.25353     0.6740E-01   3.761     0.000 0.299     0.2816      0.9394
LCW     -0.27192E-01  0.1258     -0.2161     0.829-0.018    -0.0148     -0.0657
LCD      -0.60675     0.3382      -1.794     0.075-0.148    -0.1312     -0.6878
LQ        0.17838     0.1094       1.630     0.105 0.135     0.1859      1.2605
LTF      -0.37810     0.1331      -2.840     0.005-0.230    -0.4753     -4.2861
V2        -1.8376     0.8696      -2.113     0.036-0.173    -1.8791      0.0000
CONSTANT  0.20105      2.373      0.8472E-01 0.933 0.007     0.0000      0.0873

DURBIN-WATSON = 1.2936    VON NEUMANN RATIO = 1.3021    RHO =  0.35088
RESIDUAL SUM = -0.39602E-12  RESIDUAL VARIANCE =    1.4487
SUM OF ABSOLUTE ERRORS=   140.77
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2989
```

```
RUNS TEST:    63 RUNS,    78 POS,     0 ZERO,    75 NEG  NORMAL STATISTIC = -2.3484
COEFFICIENT OF SKEWNESS =  -0.4812 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.2232 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    5.9898 P-VALUE= 0.050

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  1.0  6.0  6.0  8.0 15.0 21.0 31.0 20.0 22.0 14.0  6.0  2.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =    10.5153 WITH  4 DEGREES OF FREEDOM, P-VALUE= 0.033
|_test V2=0
TEST VALUE =  -1.8376      STD. ERROR OF TEST VALUE  0.86960
T STATISTIC =  -2.1131704      WITH  144 D.F.    P-VALUE= 0.03631
F STATISTIC =   4.4654890      WITH    1 AND  144 D.F.  P-VALUE= 0.03631
WALD CHI-SQUARE STATISTIC =   4.4654890      WITH    1 D.F.  P-VALUE= 0.03459
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.22394
|_*Testing H0:coefficent of V2 = 0 using t test  and if we reject H0 , ltrfb is
endogenous varaible. Since T stat is large and si
| gnififant at 1% we acce&
|_*pt that ltrfb is a endogenous varaible.
|_******Testing for endogeniety of ltrfc
|_sample 1 153

|_OLS ltrfc lcl lcw lcd lq ltf / hetcov  resid=V4

REQUIRED MEMORY IS PAR=      53 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.1264     R-SQUARE ADJUSTED =   0.0967
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.7682
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3297
SUM OF SQUARED ERRORS-SSE=   259.92
MEAN OF DEPENDENT VARIABLE =   2.3038
LOG OF THE LIKELIHOOD FUNCTION = -257.637

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.8375
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.60836
 SCHWARZ (1978) CRITERION - LOG SC =             0.72720
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          1.8403
 HANNAN AND QUINN (1979) CRITERION =              1.9283
 RICE (1984) CRITERION =                          1.8434
 SHIBATA (1981) CRITERION =                       1.8321
 SCHWARZ (1978) CRITERION - SC =                  2.0693
 AKAIKE (1974) INFORMATION CRITERION - AIC =      1.8374

                     ANALYSIS OF VARIANCE - FROM MEAN
                  SS          DF            MS                   F
REGRESSION       37.608          5.        7.5217               4.254
ERROR            259.92        147.        1.7682              P-VALUE
TOTAL            297.53        152.        1.9574               0.001

                     ANALYSIS OF VARIANCE - FROM ZERO
                  SS          DF            MS                   F
REGRESSION       849.66          6.        141.61               80.089
ERROR            259.92        147.        1.7682              P-VALUE
TOTAL            1109.6        153.        7.2521               0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     147 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
```

```
LCL       0.27755     0.7440E-01   3.730      0.000 0.294     0.3083     1.0284
LCW      -0.46141E-01 0.1398     -0.3301      0.742-0.027    -0.0252    -0.1115
LCD      -0.58619     0.3877      -1.512      0.133-0.124    -0.1268    -0.6645
LQ       -0.39426E-01 0.8642E-01 -0.4562      0.649-0.038    -0.0411    -0.2786
LTF      -0.91674E-01 0.6559E-01  -1.398      0.164-0.115    -0.1152    -1.0392
CONSTANT   4.7582      2.325       2.046      0.043 0.166     0.0000     2.0654

DURBIN-WATSON = 1.2225    VON NEUMANN RATIO = 1.2306    RHO =  0.38751
RESIDUAL SUM = -0.16476E-12  RESIDUAL VARIANCE =   1.7682
SUM OF ABSOLUTE ERRORS=   152.71
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1264
RUNS TEST:   55 RUNS,   89 POS,    0 ZERO,   64 NEG  NORMAL STATISTIC = -3.4104
COEFFICIENT OF SKEWNESS =  -1.0927 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   3.1968 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   89.3203 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  3.0  1.0  0.0  4.0 15.0 14.0 20.0 30.0 23.0 22.0 14.0  6.0  1.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   20.4260 WITH  7 DEGREES OF FREEDOM, P-VALUE= 0.005
 |_*using F test testing lcl, lcw and lcd correlate with ltrfc: coefficents of lcl, clw,
and lccd setting equal to 0: require high
 | er F value and signific&
 |_*ant at 1%.
 |_TEST lcl=0
TEST VALUE =  0.27755     STD. ERROR OF TEST VALUE  0.74402E-01
T STATISTIC =   3.7304234     WITH  147 D.F.    P-VALUE= 0.00027
F STATISTIC =   13.916058     WITH    1 AND  147 D.F.  P-VALUE= 0.00027
WALD CHI-SQUARE STATISTIC =   13.916058     WITH    1 D.F.  P-VALUE= 0.00019
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.07186
 |_TEST lcw=0
TEST VALUE = -0.46141E-01 STD. ERROR OF TEST VALUE  0.13977
T STATISTIC = -0.33012110     WITH  147 D.F.    P-VALUE= 0.74178
F STATISTIC =  0.10897994     WITH    1 AND  147 D.F.  P-VALUE= 0.74178
WALD CHI-SQUARE STATISTIC =  0.10897994     WITH    1 D.F.  P-VALUE= 0.74131
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 1.00000
 |_TEST lcd=0
TEST VALUE = -0.58619     STD. ERROR OF TEST VALUE  0.38775
T STATISTIC =  -1.5117954     WITH  147 D.F.    P-VALUE= 0.13273
F STATISTIC =   2.2855253     WITH    1 AND  147 D.F.  P-VALUE= 0.13273
WALD CHI-SQUARE STATISTIC =   2.2855253     WITH    1 D.F.  P-VALUE= 0.13059
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.43754
 |_end
 |_*Result : lcl and lcd correlate with ltrfc at % sig level
 |_sample 1 153

 |_OLS ltrfb ltrfc lbl lbd lq ltf V4/ hetcov

REQUIRED MEMORY IS PAR=      54 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFB
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.2211     R-SQUARE ADJUSTED =   0.1891
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.7567
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3254
SUM OF SQUARED ERRORS-SSE=   256.47
MEAN OF DEPENDENT VARIABLE =   1.9062
LOG OF THE LIKELIHOOD FUNCTION = -256.617

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.8370
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.60809
 SCHWARZ (1978) CRITERION - LOG SC =              0.74674
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MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8409
 HANNAN AND QUINN (1979) CRITERION =               1.9433
 RICE (1984) CRITERION =                           1.8451
 SHIBATA (1981) CRITERION =                        1.8297
 SCHWARZ (1978) CRITERION - SC =                   2.1101
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8369

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF           MS                 F
REGRESSION         72.792         6.        12.132              6.906
ERROR              256.47       146.        1.7567             P-VALUE
TOTAL              329.27       152.        2.1662              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF           MS                 F
REGRESSION         628.75         7.        89.822             51.132
ERROR              256.47       146.        1.7567             P-VALUE
TOTAL              885.23       153.        5.7858              0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     146 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC      0.12670     0.2422      0.5232     0.602 0.043     0.1204     0.1531
LBL        0.33922E-02 0.1471      0.2305E-01 0.982 0.002     0.0022     0.0148
LBD       -0.78937     0.5359     -1.473      0.143-0.121    -0.1294    -0.9811
LQ        -0.10312     0.9559E-01 -1.079      0.282-0.089    -0.1022    -0.8807
LTF        0.13673     0.7196E-01  1.900      0.059 0.155     0.1634     1.8731
V4         0.33631     0.2663      1.263      0.209 0.104     0.2988     0.0000
CONSTANT   1.5643       1.833      0.8535     0.395 0.070     0.0000     0.8206

DURBIN-WATSON = 1.1401    VON NEUMANN RATIO = 1.1476    RHO =  0.42337
RESIDUAL SUM = -0.29488E-12  RESIDUAL VARIANCE =   1.7567
SUM OF ABSOLUTE ERRORS=   154.30
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2211
RUNS TEST:   48 RUNS,    73 POS,     0 ZERO,    80 NEG  NORMAL STATISTIC = -4.7697
COEFFICIENT OF SKEWNESS =  -0.1029 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =  -0.0966 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    0.3764 P-VALUE= 0.828

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  0.0  2.0  6.0  3.0  8.0 17.0 27.0 33.0 16.0 16.0 10.0 11.0  4.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   17.6406 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.007
 |_Test V4=0
TEST VALUE =  0.33631     STD. ERROR OF TEST VALUE  0.26626
T STATISTIC =   1.2630853     WITH  146 D.F.    P-VALUE= 0.20857
F STATISTIC =   1.5953845     WITH    1 AND  146 D.F.  P-VALUE= 0.20857
WALD CHI-SQUARE STATISTIC =   1.5953845      WITH     1 D.F.  P-VALUE= 0.20656
UPPER BOUND ON P-VALUE BY CHEBYCHEV INEQUALITY = 0.62681
 |_*Testing H0:coefficent of V4 =  0 using t test  and if we reject H0 , ltrfc is
endogenous varaible. Since T stat is small and n
 | ot signififant at 1% we&
 |_* do not accept that ltrfc is a endogenous varaible.
 |_* We have a system of equation in the form
 |_sample 1 153

 |_2sls ltrfb ltrfc  (lbl lbd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea dprna
dprnwe dprsa dprwam)/ dn gf
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
 17 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
     153 OBSERVATIONS
DN OPTION IN EFFECT - DIVISOR IS N

 R-SQUARE =   0.1571     R-SQUARE ADJUSTED =   0.1516
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 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.8139
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3468
 SUM OF SQUARED ERRORS-SSE=   277.52
 MEAN OF DEPENDENT VARIABLE =   1.9062


                             ASYMPTOTIC
 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR    --------   P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFC     0.40906     0.1750        2.337     0.019 0.187      0.3888     0.4944
 CONSTANT  0.96383     0.4177        2.307     0.021 0.185      0.0000     0.5056

 |_OLS ltrfc ltrfb lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea
dprna dprnwe dprsa dprwam/ hetcov

 REQUIRED MEMORY IS PAR=       71 CURRENT PAR=  112400
  OLS ESTIMATION
       153 OBSERVATIONS     DEPENDENT VARIABLE= LTRFC
 ...NOTE..SAMPLE RANGE SET TO:      1,    153

 USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

  R-SQUARE =   0.4208     R-SQUARE ADJUSTED =   0.3381
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.2956
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.1383
 SUM OF SQUARED ERRORS-SSE=   172.32
 MEAN OF DEPENDENT VARIABLE =   2.3038
 LOG OF THE LIKELIHOOD FUNCTION = -226.195

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.4650
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.38036
  SCHWARZ (1978) CRITERION - LOG SC =              0.77649
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           1.4905
  HANNAN AND QUINN (1979) CRITERION =               1.7182
  RICE (1984) CRITERION =                           1.5250
  SHIBATA (1981) CRITERION =                        1.4207
  SCHWARZ (1978) CRITERION - SC =                   2.1738
  AKAIKE (1974) INFORMATION CRITERION - AIC =       1.4628

                    ANALYSIS OF VARIANCE - FROM MEAN
                       SS          DF          MS                  F
 REGRESSION        125.21         19.        6.5898              5.086
 ERROR             172.32        133.        1.2956             P-VALUE
 TOTAL             297.53        152.        1.9574              0.000

                    ANALYSIS OF VARIANCE - FROM ZERO
                       SS          DF          MS                  F
 REGRESSION        937.25         20.        46.863             36.169
 ERROR             172.32        133.        1.2956             P-VALUE
 TOTAL             1109.6        153.        7.2521              0.000


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR     133 DF    P-VALUE CORR. COEFFICIENT  AT MEANS
 LTRFB     0.36590     0.1098       3.332      0.001 0.278      0.3849     0.3028
 LCL       0.26034     0.6330E-01   4.113      0.000 0.336      0.2892     0.9647
 LCW      -0.12037     0.1069      -1.126      0.262-0.097     -0.0657    -0.2908
 LCD      -0.49740     0.3383      -1.470      0.144-0.126     -0.1076    -0.5639
 LQ        0.70452E-01 0.7044E-01   1.000      0.319 0.086      0.0734     0.4978
 LTF      -0.10562     0.5214E-01  -2.026      0.045-0.173     -0.1328    -1.1973
 DPA       -1.0538     0.5351      -1.969      0.051-0.168     -0.3526    -0.3109
 DPCOR     -1.0630     0.6405      -1.660      0.099-0.142     -0.2198    -0.0422
 DPC      -0.58491     0.5148      -1.136      0.258-0.098     -0.1686    -0.0514
 DPGL     -0.39874     0.3198      -1.247      0.215-0.107     -0.1427    -0.0814
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 DPGS       0.18237      0.3660      0.4983      0.619 0.043     0.0538     0.0171
 DPGSL      0.14463      0.3199      0.4522      0.652 0.039     0.0466     0.0176
 DPRAF     -0.42521      0.5876     -0.7237      0.471-0.063    -0.0754    -0.0121
 DPRAU      0.57601      0.3674      1.568       0.119 0.135     0.1152     0.0212
 DPREA     -0.35695      0.3785     -0.9431      0.347-0.082    -0.0946    -0.0253
 DPRNA     -0.19964      0.4476     -0.4460      0.656-0.039    -0.0337    -0.0051
 DPRNWE    -0.14589      0.3583     -0.4072      0.685-0.035    -0.0483    -0.0195
 DPRSA      0.38344      0.3409      1.125       0.263 0.097     0.0983     0.0250
 DPRWAM     0.24791      0.4022      0.6164      0.539 0.053     0.0496     0.0091
 CONSTANT   4.0191       1.769       2.271       0.025 0.193     0.0000     1.7445

 DURBIN-WATSON = 1.4702    VON NEUMANN RATIO = 1.4798    RHO =  0.26139
 RESIDUAL SUM =  0.33662E-12  RESIDUAL VARIANCE =   1.2956
 SUM OF ABSOLUTE ERRORS=   127.69
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4208
 RUNS TEST:   67 RUNS,   83 POS,     0 ZERO,    70 NEG  NORMAL STATISTIC = -1.6256
 COEFFICIENT OF SKEWNESS =  -0.4168 WITH STANDARD DEVIATION OF 0.1961
 COEFFICIENT OF EXCESS KURTOSIS =   0.5589 WITH STANDARD DEVIATION OF 0.3898

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    5.9484 P-VALUE= 0.051

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 30 GROUPS
 OBSERVED  1.0  1.0  0.0  0.0  1.0  1.0  5.0  5.0  1.0  4.0 10.0  8.0 13.0 11.0  9.0 15.0
16.0 15.0  6.0  9.0
           9.0  4.0  3.0  2.0  4.0  0.0  0.0  0.0  0.0  0.0
 EXPECTED  0.4  0.3  0.5  0.9  1.4  2.0  2.9  4.0  5.2  6.7  8.1  9.5 10.8 11.6 12.1 12.1
11.6 10.8  9.5  8.1
           6.7  5.2  4.0  2.9  2.0  1.4  0.9  0.5  0.3  0.4
 CHI-SQUARE =   25.1405 WITH  8 DEGREES OF FREEDOM, P-VALUE= 0.001
 |_*model specification test
 |_diagnos / reset

 REQUIRED MEMORY IS PAR=      87 CURRENT PAR=  112400
 DEPENDENT VARIABLE = LTRFC           153 OBSERVATIONS
 REGRESSION COEFFICIENTS
   0.365897262336       0.260342809221      -0.120369560416      -0.497396885957
   0.704515505866E-01 -0.105618693119      -1.05380648826       -1.06298598943
  -0.584914071865     -0.398739733943       0.182372106650       0.144634403645
  -0.425210161735      0.576007984842      -0.356947445750      -0.199642312777
  -0.145892103852      0.383438922510       0.247908965004       4.01907483636


 RAMSEY RESET SPECIFICATION TESTS USING POWERS OF YHAT
   RESET(2)=    6.7693     - F WITH DF1=   1 AND DF2= 132 P-VALUE= 0.010
   RESET(3)=    4.2009     - F WITH DF1=   2 AND DF2= 131 P-VALUE= 0.017
   RESET(4)=    4.9849     - F WITH DF1=   3 AND DF2= 130 P-VALUE= 0.003

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETL
  FRESET(1)=   1.8299     - F WITH DF1=   2 AND DF2= 131 P-VALUE= 0.165
  FRESET(2)=   3.8509     - F WITH DF1=   4 AND DF2= 129 P-VALUE= 0.005
  FRESET(3)=   3.6612     - F WITH DF1=   6 AND DF2= 127 P-VALUE= 0.002

 DEBENEDICTIS-GILES FRESET SPECIFICATION TESTS USING FRESETS
  FRESET(1)=   1.3039     - F WITH DF1=   2 AND DF2= 131 P-VALUE= 0.275
  FRESET(2)=   1.7407     - F WITH DF1=   4 AND DF2= 129 P-VALUE= 0.145
  FRESET(3)=   1.4546     - F WITH DF1=   6 AND DF2= 127 P-VALUE= 0.199
 |_************testing for over
identification****************************************************************************
********
 | *
 |_***LtrfcI
 |_sample 1 153

 |_2SLS ltrfc ltrfb lcw (lcl lcw lcd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau
dprea dprna dprnwe dprsa dprwam ) / resid=U1
  TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
  18 EXOGENOUS VARIABLES
   2 POSSIBLE ENDOGENOUS VARIABLES
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      153 OBSERVATIONS

 R-SQUARE =   0.1644     R-SQUARE ADJUSTED =   0.1532
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6575
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2874
SUM OF SQUARED ERRORS-SSE=   248.62
MEAN OF DEPENDENT VARIABLE =   2.3038


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     150 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.41569     0.1396      2.977     0.003 0.236     0.4373     0.3440
LCW      -0.17206     0.1368     -1.258     0.210-0.102    -0.0939    -0.4157
CONSTANT   2.4690     0.8029      3.075     0.003 0.244     0.0000     1.0717
|_*regress 2SLS residual U1 on all exogeneous varaibles

|_OLS U1 lcl lcw lcd lq ltf/ hetcov

REQUIRED MEMORY IS PAR=       54 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= U1
...NOTE..SAMPLE RANGE SET TO:       1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.1387     R-SQUARE ADJUSTED =   0.1094
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.4567
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2069
SUM OF SQUARED ERRORS-SSE=   214.14
MEAN OF DEPENDENT VARIABLE =  0.97090E-15
LOG OF THE LIKELIHOOD FUNCTION = -242.816

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.5139
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.41462
 SCHWARZ (1978) CRITERION - LOG SC =              0.53346
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.5162
 HANNAN AND QUINN (1979) CRITERION =               1.5887
 RICE (1984) CRITERION =                           1.5187
 SHIBATA (1981) CRITERION =                        1.5094
 SCHWARZ (1978) CRITERION - SC =                   1.7048
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.5138

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                  F
REGRESSION         34.486          5.         6.8971              4.735
ERROR              214.14        147.         1.4567            P-VALUE
TOTAL              248.62        152.         1.6357              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                  F
REGRESSION         34.486          6.         5.7476              3.946
ERROR              214.14        147.         1.4567            P-VALUE
TOTAL              248.62        153.         1.6250              0.001


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     147 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LCL       0.26260     0.6750E-01   3.890    0.000 0.306     0.3191***********
LCW       0.91189E-01 0.1203      0.7580    0.450 0.062     0.0545***********
LCD      -0.44181     0.3090      -1.430    0.155-0.117    -0.1045***********
LQ        0.24346E-01 0.7747E-01  0.3143    0.754 0.026     0.0278***********
LTF      -0.13739     0.6004E-01  -2.288    0.024-0.185    -0.1889***********
CONSTANT   1.5964      1.919      0.8319    0.407 0.068     0.0000***********
```

```
DURBIN-WATSON = 1.2268    VON NEUMANN RATIO = 1.2348    RHO =  0.38310
RESIDUAL SUM = -0.23537E-13  RESIDUAL VARIANCE =   1.4567
SUM OF ABSOLUTE ERRORS=   143.33
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1387
RUNS TEST:   55 RUNS,   80 POS,     0 ZERO,    73 NEG  NORMAL STATISTIC = -3.6317
COEFFICIENT OF SKEWNESS =  -0.4805 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.0012 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    5.7816 P-VALUE= 0.056

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  1.0  8.0  5.0  8.0 15.0 21.0 29.0 19.0 18.0 20.0  7.0  1.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   19.6169 WITH  7 DEGREES OF FREEDOM, P-VALUE= 0.006
|_GEN1 teststat=$N*$R2
...NOTE..CURRENT VALUE OF $N   =   153.00
...NOTE..CURRENT VALUE OF $R2  =  0.13871
|_GEN1 k=2-1
|_sample 1 1
|_Distrib teststat / type=CHI df=k cdf=cdf
CHI-SQUARE PARAMETERS- DF=   1.0000
MEAN=   1.0000     VARIANCE=   2.0000     MODE=  0.00000E+00

               DATA        PDF        CDF        1-CDF
  TESTSTAT
 ROW     1     21.222     0.21341E-05  1.0000     0.40903E-05
|_GEN1 p_value=1-cdf
|_print teststat p_value
      TESTSTAT        P_VALUE
   21.22204      0.4090330E-05
|_**ltrfcII
|_sample 1 153

|_2SLS ltrfc ltrfb lcl (lcl lcw lcd lq ltf ) / resid=U1
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFC
  5 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS

 R-SQUARE =   0.1652     R-SQUARE ADJUSTED =   0.1541
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6559
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2868
SUM OF SQUARED ERRORS-SSE=   248.38
MEAN OF DEPENDENT VARIABLE =   2.3038


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     150 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFB     0.11091     0.3534     0.3138     0.754 0.026     0.1167     0.0918
LCL       0.26444     0.6752E-01   3.917     0.000 0.305     0.2937     0.9798
CONSTANT -0.16493     0.8470    -0.1947     0.846-0.016     0.0000    -0.0716
|_*regress 2SLS residual U1 on all exogeneous varaibles

|_OLS U1 lcl lcw lcd lq ltf/ hetcov

REQUIRED MEMORY IS PAR=      54 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= U1
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.0457     R-SQUARE ADJUSTED =   0.0132
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.6124
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.2698
SUM OF SQUARED ERRORS-SSE=   237.03
MEAN OF DEPENDENT VARIABLE =  0.92156E-15
LOG OF THE LIKELIHOOD FUNCTION = -250.585
```

```
MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =       1.6757
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.51617
 SCHWARZ (1978) CRITERION - LOG SC =             0.63501
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =            1.6782
 HANNAN AND QUINN (1979) CRITERION =                1.7585
 RICE (1984) CRITERION =                            1.6810
 SHIBATA (1981) CRITERION =                         1.6707
 SCHWARZ (1978) CRITERION - SC =                    1.8870
 AKAIKE (1974) INFORMATION CRITERION - AIC =        1.6756

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                 F
REGRESSION        11.353          5.        2.2706               1.408
ERROR             237.03        147.        1.6124             P-VALUE
TOTAL             248.38        152.        1.6341               0.225

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                 F
REGRESSION        11.353          6.        1.8922               1.173
ERROR             237.03        147.        1.6124             P-VALUE
TOTAL             248.38        153.        1.6234               0.324


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     147 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LCL       0.91238E-02 0.7034E-01  0.1297     0.897 0.011      0.0111***********
LCW      -0.55406E-01 0.1309     -0.4231     0.673-0.035     -0.0331***********
LCD      -0.54767     0.3582     -1.529      0.128-0.125     -0.1296***********
LQ       -0.22412E-01 0.8242E-01 -0.2719     0.786-0.022     -0.0256***********
LTF      -0.10387     0.6264E-01 -1.658      0.099-0.136     -0.1429***********
CONSTANT   4.7383      2.184      2.170      0.032 0.176      0.0000***********

DURBIN-WATSON = 1.2281    VON NEUMANN RATIO = 1.2362    RHO =  0.38428
RESIDUAL SUM = -0.13856E-12  RESIDUAL VARIANCE =   1.6124
SUM OF ABSOLUTE ERRORS=   146.58
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0457
RUNS TEST:   57 RUNS,   85 POS,    0 ZERO,   68 NEG  NORMAL STATISTIC = -3.2123
COEFFICIENT OF SKEWNESS =  -0.9400 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   2.2239 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   50.5513 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  2.0  2.0  1.0  7.0  8.0 16.0 18.0 32.0 23.0 21.0 16.0  6.0  1.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   14.9091 WITH  7 DEGREES OF FREEDOM, P-VALUE= 0.037
|_GEN1 teststat=$N*$R2
...NOTE..CURRENT VALUE OF $N   =   153.00
...NOTE..CURRENT VALUE OF $R2  =  0.45708E-01
|_GEN1 k=2-1
|_sample 1 1
|_Distrib teststat / type=CHI df=k cdf=cdf
CHI-SQUARE PARAMETERS- DF=   1.0000
MEAN=   1.0000     VARIANCE=   2.0000     MODE=  0.00000E+00

               DATA        PDF        CDF        1-CDF
  TESTSTAT
 ROW     1     6.9933     0.45708E-02 0.99182     0.81815E-02
|_GEN1 p_value=1-cdf
|_print teststat p_value
      TESTSTAT        P_VALUE
   6.993316      0.8181463E-02
|_**ltrfbI
```

```
|_sample 1 153

|_2SLS ltrfb ltrfc lbl (lbl lbd lq ltf dpa dpcor dpc dpgl dpgs dpgsl dpraf dprau dprea
dprna dprnwe dprsa dprwam)/ resid=U2 gf
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
 17 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
     153 OBSERVATIONS

 R-SQUARE =   0.1574     R-SQUARE ADJUSTED =   0.1462
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.8496
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3600
SUM OF SQUARED ERRORS-SSE=   277.44
MEAN OF DEPENDENT VARIABLE =   1.9062


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     150 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC     0.38555     0.1855      2.079     0.039 0.167     0.3665     0.4660
LBL      -0.51673E-01 0.1236     -0.4182    0.676-0.034    -0.0329    -0.2262
CONSTANT   1.4492      1.235      1.174     0.242 0.095     0.0000     0.7602

|_OLS U2 lbd lcl lcw lcd lq ltf/ hetcov

REQUIRED MEMORY IS PAR=      57 CURRENT PAR=  112400
 OLS ESTIMATION
     153 OBSERVATIONS     DEPENDENT VARIABLE= U2
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX

 R-SQUARE =   0.0738     R-SQUARE ADJUSTED =   0.0358
VARIANCE OF THE ESTIMATE-SIGMA**2 =   1.7600
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.3266
SUM OF SQUARED ERRORS-SSE=   256.96
MEAN OF DEPENDENT VARIABLE = -0.11066E-14
LOG OF THE LIKELIHOOD FUNCTION = -256.760

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      1.8405
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.60997
 SCHWARZ (1978) CRITERION - LOG SC =              0.74862
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           1.8444
 HANNAN AND QUINN (1979) CRITERION =               1.9470
 RICE (1984) CRITERION =                           1.8486
 SHIBATA (1981) CRITERION =                        1.8331
 SCHWARZ (1978) CRITERION - SC =                   2.1141
 AKAIKE (1974) INFORMATION CRITERION - AIC =       1.8404

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                 F
REGRESSION        20.488          6.        3.4147              1.940
ERROR             256.96        146.        1.7600            P-VALUE
TOTAL             277.44        152.        1.8253              0.078

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                 F
REGRESSION        20.488          7.        2.9269              1.663
ERROR             256.96        146.        1.7600            P-VALUE
TOTAL             277.44        153.        1.8134              0.122


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     146 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LBD      -0.87099     0.5099     -1.708     0.090-0.140    -0.1556***********
```

```
LCL      -0.74143E-01 0.8858E-01 -0.8370     0.404-0.069    -0.0853***********
LCW       0.13976     0.1508      0.9267     0.356 0.076     0.0790***********
LCD       0.37104E-01 0.3925      0.9452E-01 0.925 0.008     0.0083***********
LQ       -0.62916E-01 0.8951E-01 -0.7029     0.483-0.058    -0.0679***********
LTF       0.16068     0.6856E-01   2.344     0.020 0.190     0.2092***********
CONSTANT  -1.3502      1.895     -0.7127     0.477-0.059     0.0000***********

DURBIN-WATSON = 1.1339    VON NEUMANN RATIO = 1.1413    RHO =  0.42690
RESIDUAL SUM =  0.36504E-12  RESIDUAL VARIANCE =   1.7600
SUM OF ABSOLUTE ERRORS=   154.31
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0738
RUNS TEST:   44 RUNS,   75 POS,     0 ZERO,    78 NEG  NORMAL STATISTIC = -5.4319
COEFFICIENT OF SKEWNESS =  -0.1679 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   0.0355 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=    0.7048 P-VALUE= 0.703

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  2.0  5.0  3.0 11.0 13.0 31.0 29.0 19.0 14.0 10.0 12.0  3.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   16.4620 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.011
|_GEN1 testst1=$N*$R2
...NOTE..CURRENT VALUE OF $N   =   153.00
...NOTE..CURRENT VALUE OF $R2  =  0.73846E-01
|_GEN1 k1=2-1
|_sample 1 1
|_Distrib testst1 / type=CHI df=k1 cdf=cdf1
CHI-SQUARE PARAMETERS- DF=   1.0000
MEAN=   1.0000     VARIANCE=   2.0000     MODE=  0.00000E+00

               DATA        PDF        CDF        1-CDF
  TESTST1
 ROW     1     11.298     0.41782E-03 0.99922     0.77575E-03
|_GEN1 p_value1=1-cdf1
|_print testst1 p_value1
      TESTST1         P_VALUE1
   11.29838      0.7757478E-03
|_**ltrfbII
|_sample 1 153

|_2SLS ltrfb ltrfc lbl (lbl lbd lq ltf )/ resid=U2 gf
 TWO STAGE LEAST SQUARES - DEPENDENT VARIABLE = LTRFB
  4 EXOGENOUS VARIABLES
  2 POSSIBLE ENDOGENOUS VARIABLES
      153 OBSERVATIONS

 R-SQUARE =  -0.0277     R-SQUARE ADJUSTED =  -0.0414
VARIANCE OF THE ESTIMATE-SIGMA**2 =    2.2559
STANDARD ERROR OF THE ESTIMATE-SIGMA =    1.5020
SUM OF SQUARED ERRORS-SSE=   338.38
MEAN OF DEPENDENT VARIABLE =   1.9062


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     150 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LTRFC    -0.44656E-01 0.5822     -0.7671E-01 0.939-0.006    -0.0424    -0.0540
LBL      -0.13853     0.1753     -0.7903     0.431-0.064    -0.0882    -0.6064
CONSTANT   3.1650      2.566       1.234     0.219 0.100     0.0000     1.6603

|_OLS U2 lbd lcl lcw lcd lq ltf/ hetcov

REQUIRED MEMORY IS PAR=      57 CURRENT PAR=  112400
 OLS ESTIMATION
      153 OBSERVATIONS     DEPENDENT VARIABLE= U2
...NOTE..SAMPLE RANGE SET TO:      1,    153

USING HETEROSKEDASTICITY-CONSISTENT COVARIANCE MATRIX
```

```
 R-SQUARE =   0.0541     R-SQUARE ADJUSTED =   0.0152
VARIANCE OF THE ESTIMATE-SIGMA**2 =   2.1923
STANDARD ERROR OF THE ESTIMATE-SIGMA =   1.4807
SUM OF SQUARED ERRORS-SSE=   320.08
MEAN OF DEPENDENT VARIABLE = -0.13787E-14
LOG OF THE LIKELIHOOD FUNCTION = -273.565

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      2.2926
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  0.82964
 SCHWARZ (1978) CRITERION - LOG SC =              0.96829
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           2.2975
 HANNAN AND QUINN (1979) CRITERION =               2.4253
 RICE (1984) CRITERION =                           2.3027
 SHIBATA (1981) CRITERION =                        2.2835
 SCHWARZ (1978) CRITERION - SC =                   2.6334
 AKAIKE (1974) INFORMATION CRITERION - AIC =       2.2925

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF            MS                  F
REGRESSION        18.300          6.         3.0500               1.391
ERROR             320.08        146.         2.1923             P-VALUE
TOTAL             338.38        152.         2.2262               0.222

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF            MS                  F
REGRESSION        18.300          7.         2.6143               1.192
ERROR             320.08        146.         2.1923             P-VALUE
TOTAL             338.38        153.         2.2116               0.311


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     146 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
LBD      -0.94290     0.5229     -1.803     0.073-0.148    -0.1525***********
LCL       0.41393E-01 0.9903E-01  0.4180    0.677 0.035     0.0431***********
LCW       0.14179     0.1739      0.8152    0.416 0.067     0.0726***********
LCD      -0.24236     0.4736     -0.5117    0.610-0.042    -0.0491***********
LQ       -0.43824E-01 0.1014     -0.4323    0.666-0.036    -0.0428***********
LTF       0.13077     0.7630E-01  1.714     0.089 0.140     0.1542***********
CONSTANT -0.97735      2.318     -0.4216    0.674-0.035     0.0000***********

DURBIN-WATSON = 1.1527    VON NEUMANN RATIO = 1.1603    RHO =  0.41933
RESIDUAL SUM =  0.34761E-12  RESIDUAL VARIANCE =   2.1923
SUM OF ABSOLUTE ERRORS=   165.85
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0541
RUNS TEST:   54 RUNS,   75 POS,    0 ZERO,   78 NEG  NORMAL STATISTIC = -3.8090
COEFFICIENT OF SKEWNESS =  -0.7431 WITH STANDARD DEVIATION OF 0.1961
COEFFICIENT OF EXCESS KURTOSIS =   2.0795 WITH STANDARD DEVIATION OF 0.3898

JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=   38.6277 P-VALUE= 0.000

     GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 15 GROUPS
OBSERVED  1.0  1.0  7.0  4.0  6.0 14.0 23.0 36.0 20.0 18.0 13.0  6.0  4.0  0.0  0.0
EXPECTED  0.7  1.4  3.4  6.9 11.9 17.7 22.4 24.3 22.4 17.7 11.9  6.9  3.4  1.4  0.7
CHI-SQUARE =   17.4648 WITH  6 DEGREES OF FREEDOM, P-VALUE= 0.008
|_GEN1 testst1=$N*$R2
...NOTE..CURRENT VALUE OF $N   =   153.00
...NOTE..CURRENT VALUE OF $R2  =  0.54082E-01
|_GEN1 k1=2-1
|_sample 1 1
|_Distrib testst1 / type=CHI df=k1 cdf=cdf1
CHI-SQUARE PARAMETERS- DF=   1.0000
MEAN=   1.0000     VARIANCE=   2.0000     MODE=  0.00000E+00

               DATA        PDF        CDF        1-CDF


  TESTST1
 ROW      1      8.2745      0.22144E-02 0.99598      0.40206E-02
|_GEN1 p_value1=1-cdf1
|_print testst1 p_value1
     TESTST1          P_VALUE1
   8.274500       0.4020573E-02
|_stop
```

APPENDIX VIII: EFA SPSS OUTPUT (FINAL MODEL)-FACTORS INFLUENTIAL TO INFRASTRUCTURE TARIFF DESIGN

Notes

Output Created		28-MAR-2014 13:27:09
Comments		
Input	Data	C:\Users\ybandara\Documents\World Port Statistics\Survey Data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	67
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES B1_1Costbased B1_2Marketbased B1_4Discriminatory B2_1Costbased B2_2Marketbased C1Recover_invest_costs C2Compete_rivals C3Attract_cargo_users C4Incr_capa_utiliza C5Cover_oper_costs C6Prom_reg_ed D1Infra_invest_cost D4Ffinan_posi D5Percei_SQ D6Finan_cost_users D7Trade_flow D9Vary_ship_size D10Comp_port_tariffs /MISSING LISTWISE /ANALYSIS B1_1Costbased B1_2Marketbased B1_4Discriminatory B2_1Costbased B2_2Marketbased C1Recover_invest_costs C2Compete_rivals C3Attract_cargo_users C4Incr_capa_utiliza C5Cover_oper_costs C6Prom_reg_ed D1Infra_invest_cost D4Ffinan_posi D5Percei_SQ D6Finan_cost_users D7Trade_flow D9Vary_ship_size D10Comp_port_tariffs /PRINT INITIAL KMO EXTRACTION ROTATION /FORMAT SORT /CRITERIA MINEIGEN(1) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.02
	Maximum Memory Required	40024 (39.086K) bytes

```
[DataSet1] C:\Users\ybandara\Documents\World Port Statistics\Survey
Data.sav
```

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.674
Bartlett's Test of Sphericity	Approx. Chi-Square	670.865
	df	153
	Sig.	.000

Communalities

	Initial	Extraction
B1_1Costbased	1.000	.724
B1_2Marketbased	1.000	.838
B1_4Discriminatory	1.000	.389
B2_1Costbased	1.000	.755
B2_2Marketbased	1.000	.704
C1Recover_invest_costs	1.000	.833
C2Compete_rivals	1.000	.777
C3Attract_cargo_users	1.000	.783
C4Incr_capa_utiliza	1.000	.835
C5Cover_oper_costs	1.000	.653
C6Prom_reg_ed	1.000	.682
D1Infra_invest_cost	1.000	.746
D4Ffinan_posi	1.000	.644
D5Percei_SQ	1.000	.749
D6Finan_cost_users	1.000	.775
D7Trade_flow	1.000	.749
D9Vary_ship_size	1.000	.593
D10Comp_port_tariffs	1.000	.822

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.61	31.193	31.193	5.61	31.193	31.193	3.48	19.351	19.351
2	2.29	12.757	43.950	2.29	12.757	43.950	2.79	15.516	34.867
3	1.82	10.124	54.073	1.82	10.124	54.073	2.34	13.049	47.916
4	1.78	9.923	63.997	1.78	9.923	63.997	2.27	12.621	60.537
5	1.53	8.517	72.514	1.53	8.517	72.514	2.15	11.976	72.514
6	.811	4.507	77.020						
7	.727	4.040	81.060						
8	.658	3.653	84.714						
9	.584	3.245	87.958						
10	.488	2.711	90.669						
11	.342	1.899	92.569						
12	.290	1.609	94.177						
13	.264	1.465	95.643						
14	.235	1.304	96.946						
15	.225	1.249	98.195						
16	.126	.699	98.894						
17	.115	.640	99.534						
18	.084	.466	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component				
	1	2	3	4	5
D6Finan_cost_users	.798	-.025	-.346	-.007	.133
D5Percei_SQ	.743	-.255	-.330	.111	-.101
B2_1Costbased	.737	.333	-.290	-.101	.082
D7Trade_flow	.653	-.434	-.255	-.133	-.229
D1Infra_invest_cost	.636	.182	-.155	.236	.479
B2_2Marketbased	.633	.319	.003	-.448	.010
C3Attract_cargo_users	.577	-.301	.525	.028	-.287
C4Incr_capa_utiliza	.546	-.321	.167	.481	-.419
D10Comp_port_tariffs	.540	-.464	.277	-.445	.199
C5Cover_oper_costs	.462	.211	.326	.440	.309
B1_4Discriminatory	.416	.395	.124	-.044	-.208
B1_2Marketbased	.433	.667	.260	-.275	-.249
B1_1Costbased	.489	.578	.190	-.222	-.256
C2Compete_rivals	.258	-.379	.634	-.363	.184
D4Ffinan_posi	.553	-.123	-.561	-.051	-.082
C1Recover_invest_costs	.378	.269	.266	.533	.513
C6Prom_reg_ed	.468	-.157	.159	.517	-.382
D9Vary_ship_size	.427	-.389	.041	-.231	.451

Extraction Method: Principal Component Analysis. a. 5 components extracted.

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5
D4Ffinan_posi	.792	.068	-.041	.086	-.051
D6Finan_cost_users	.787	.217	.150	.106	.273
D5Percei_SQ	.762	.061	.123	.372	.103
D7Trade_flow	.696	.038	.306	.368	-.185
B2_1Costbased	.644	.510	.009	-.036	.281
B1_2Marketbased	-.017	.912	.008	.026	.073
B1_1Costbased	.081	.839	.007	.085	.077
B2_2Marketbased	.391	.671	.288	-.118	.061
B1_4Discriminatory	.104	.580	-.035	.165	.117
D10Comp_port_tariffs	.289	.072	.853	.082	-.011
C2Compete_rivals	-.178	.068	.852	.117	.031
D9Vary_ship_size	.366	-.137	.622	-.097	.211
C4Incr_capa_utiliza	.240	.012	.062	.871	.121
C6Prom_reg_ed	.162	.068	-.059	.783	.185
C3Attract_cargo_users	.042	.247	.520	.669	.045
C1Recover_invest_costs	-.014	.076	.019	.112	.902
C5Cover_oper_costs	.007	.182	.093	.255	.739
D1Infra_invest_cost	.500	.144	.072	-.038	.685

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 7 iterations.

Component Transformation Matrix

Component	1	2	3	4	5
1	.659	.447	.341	.368	.338
2	-.189	.719	-.506	-.330	.287
3	-.722	.240	.521	.322	.213
4	-.082	-.358	-.509	.537	.563
5	.047	-.312	.310	-.603	.664

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX IX: CFA AMOS OUTPUT (FINAL MODEL)-FACTORS INFLUENTIAL TO INFRASTRUCTURE TARIFF DESIGN

Analysis Summary

Date and Time
Date: Monday, 29 September 2014
Time: 5:26:11 PM

Title

Cfa b1-d11 model 3: Monday, 29 September 2014 5:26 PM

Notes for Group (Group number 1)

The model is recursive.
Sample size = 67

Variable Summary (Group number 1)

Your model contains the following variables (Group number 1)
Observed, endogenous variables

B1_1Costbased
B1_2Marketbased
C4Incr_capa_utiliza
C6Prom_reg_ed
C3Attract_cargo_users
C1Recover_invest_costs
C5Cover_oper_costs
D7Trade_flow
D5Percei_SQ
Unobserved, exogenous variables
Pricing_Knowledge_Applicability
e5
e9
Tariff_Objective
e13
e14
e15
Cost_Recovery
e16
e17
Port_Demand
e19
e20

Variable counts (Group number 1)

Number of variables in your model:	22
Number of observed variables:	9
Number of unobserved variables:	13
Number of exogenous variables:	13
Number of endogenous variables:	9

Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	14	0	0	0	0	14
Labeled	0	0	0	0	0	0
Unlabeled	4	3	13	0	0	20
Total	18	3	13	0	0	34

Sample Covariances (Group number 1)

	D5Perce i_SQ	D7Trade_ flow	C5Cover_oper _costs	C1Recover_inve st_costs	C3Attract_carg o_users	C6Prom_r eg_ed	C4Incr_capa_ utiliza	B1_2 Marketbased	B1_1 Cost based
D5Perce i_SQ	4.505								
D7Trade _flow	2.479	4.041							
C5Cover _oper_c osts	.652	.497	5.190						
C1Reco ver_inve st_costs	.724	-.370	2.858	4.443					
C3Attra ct_cargo _users	1.438	1.932	1.172	.831	4.476				
C6Prom _reg_ed	1.966	1.396	1.598	1.031	1.917	5.444			
C4Incr_ capa_uti liza	2.383	1.906	1.400	.938	2.910	3.182	4.724		
B1_2Ma rketbase d	.172	.215	.684	.511	.800	.339	.124	2.285	
B1_1Co stbased	.434	.364	.646	.505	.598	.618	.284	1.611	1.830

Condition number = 37.074
Eigenvalues
14.808 6.973 3.743 3.431 2.943 2.277 1.373 .991 .399
Determinant of sample covariance matrix = 4829.061

Sample Correlations (Group number 1)

	D5Perce i_SQ	D7Trade_flow	C5Cover_oper_costs	C1Recover_invest_costs	C3Attract_cargo_users	C6Prom_reg_ed	C4Incr_capa_utiliza	B1_2Marketbased	B1_1Costbased
D5Percei_SQ	1.000								
D7Trade_flow	.581	1.000							
C5Cover_oper_costs	.135	.109	1.000						
C1Recover_invest_costs	.162	-.087	.595	1.000					
C3Attract_cargo_users	.320	.454	.243	.186	1.000				
C6Prom_reg_ed	.397	.298	.301	.210	.388	1.000			
C4Incr_capa_utiliza	.517	.436	.283	.205	.633	.628	1.000		
B1_2Marketbased	.053	.071	.199	.160	.250	.096	.038	1.000	
B1_1Costbased	.151	.134	.210	.177	.209	.196	.097	.788	1.000

Condition number = 17.310
Eigenvalues
3.274 1.764 1.356 .749 .657 .487 .297 .226 .189

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	45
Number of distinct parameters to be estimated:	20
Degrees of freedom (45 - 20):	25

Result (Default model)

Minimum was achieved
Chi-square = 27.857
Degrees of freedom = 25
Probability level = .314

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
B1_1Costbased	<-	Pricing_Knowledge_ Applicability	1.000				
B1_2Marketbased	<-	Pricing_Knowledge_ Applicability	1.041	.417	2.493	.013	par_1
C4Incr_capa_utiliza	<-	Tariff_Objective	1.000				
C6Prom_reg_ed	<-	Tariff_Objective	.760	.140	5.434	***	par_2
C3Attract_cargo_user s	<-	Tariff_Objective	.696	.127	5.488	***	par_3
C1Recover_invest_co sts	<-	Cost_Recovery	1.000				
C5Cover_oper_costs	<-	Cost_Recovery	1.000				
D7Trade_flow	<-	Port_Demand	.902	.207	4.367	***	par_7
D5Percei_SQ	<-	Port_Demand	1.000				

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
B1_1Costbased	<---	Pricing_Knowledge_Applicability	.920
B1_2Marketbased	<---	Pricing_Knowledge_Applicability	.857
C4Incr_capa_utiliza	<---	Tariff_Objective	.937
C6Prom_reg_ed	<---	Tariff_Objective	.660
C3Attract_cargo_users	<---	Tariff_Objective	.666
C1Recover_invest_costs	<---	Cost_Recovery	.789
C5Cover_oper_costs	<---	Cost_Recovery	.749
D7Trade_flow	<---	Port_Demand	.744
D5Percei_SQ	<---	Port_Demand	.781

Implied Covariances (Group number 1 - Default model)

	D5Percei_SQ	D7Trade_flow	C5Cover_oper_costs	C1Recover_invest_costs	C3Attract_cargo_users	C6Prom_reg_ed	C4Incr_capa_utiliza	B1_2Marketbased	B1_1Costbased
D5Percei_SQ	4.505								
D7Trade_flow	2.479	4.041							
C5Cover_oper_costs	.000	.000	5.030						
C1Recover_invest_costs	.000	.000	2.820	4.526					
C3Attract_cargo_users	1.545	1.394	.654	.654	4.434				
C6Prom_reg_ed	1.688	1.523	.715	.715	2.151	5.393			
C4Incr_capa_utiliza	2.219	2.003	.940	.940	2.830	3.091	4.635		
B1_2Marketbased	.000	.000	.549	.549	.000	.000	.000	2.285	
B1_1Costbased	.000	.000	.528	.528	.000	.000	.000	1.611	1.830

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	20	27.857	25	.314	1.114
Saturated model	45	.000	0		
Independence model	9	246.445	36	.000	6.846

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.343	.920	.856	.511
Saturated model	.000	1.000		
Independence model	1.277	.527	.409	.422

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.887	.837	.987	.980	.986
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.694	.616	.685
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	2.857	.000	20.010
Saturated model	.000	.000	.000
Independence model	210.445	164.416	263.968

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.422	.043	.000	.303
Saturated model	.000	.000	.000	.000
Independence model	3.734	3.189	2.491	4.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.042	.000	.110	.526
Independence model	.298	.263	.333	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	67.857	75.000	111.951	131.951
Saturated model	90.000	106.071	189.211	234.211
Independence model	264.445	267.660	284.288	293.288

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	1.028	.985	1.288	1.136
Saturated model	1.364	1.364	1.364	1.607
Independence model	4.007	3.309	4.818	4.055

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	90	105
Independence model	14	16

APPENDIX X: EFA SPSS OUTPUT (FINAL MODEL)-FACTORS INFLUENTIAL TO INFRASTRUCTURE TARIFF SETTING PRACTICES

Notes

Output Created		25-MAR-2014 17:27:03
Comments		
Input	Data	C:\Users\ybandara\Documents\World Port Statistics\Survey Data.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	67
Missing Value Handling	Definition of Missing	MISSING=EXCLUDE: User-defined missing values are treated as missing.
	Cases Used	LISTWISE: Statistics are based on cases with no missing values for any variable used.
Syntax		FACTOR /VARIABLES E1_3Appr_gov_revi E1_4Feedback_users E1_5Feedback_operators E2_1Policy_design_revi E2_2Policy_rebates E2_4Tariffs_regulatory E2_5Compo_tariff E2_7Nego_tariffs E2_8Adhere_publi_tariffs E2_9Lumpsum_fee E3_2Adj_tariff_P_LKc E3_4Revis_strat_plan E3_5Revis_compet_posi E4_3Comm_Plan_Dept /MISSING LISTWISE /ANALYSIS E1_3Appr_gov_revi E1_4Feedback_users E1_5Feedback_operators E2_1Policy_design_revi E2_2Policy_rebates E2_4Tariffs_regulatory E2_5Compo_tariff E2_7Nego_tariffs E2_8Adhere_publi_tariffs E2_9Lumpsum_fee E3_2Adj_tariff_P_LKc E3_4Revis_strat_plan E3_5Revis_compet_posi E4_3Comm_Plan_Dept /PRINT INITIAL EXTRACTION ROTATION /FORMAT SORT /CRITERIA FACTORS(4) ITERATE(25) /EXTRACTION PC /CRITERIA ITERATE(25) /ROTATION VARIMAX /SAVE REG(ALL) /METHOD=CORRELATION.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.05
	Maximum Memory Required	26824 (26.195K) bytes
Variables Created	FAC1_88	Component score 1
	FAC2_88	Component score 2
	FAC3_88	Component score 3
	FAC4_88	Component score 4

```
[DataSet1] C:\Users\ybandara\Documents\World Port Statistics\Survey
Data.sav
```

Communalities

	Initial	Extraction
E1_3Appr_gov_revi	1.000	.658
E1_4Feedback_users	1.000	.883
E1_5Feedback_operators	1.000	.853
E2_1Policy_design_revi	1.000	.750
E2_2Policy_rebates	1.000	.549
E2_4Tariffs_regulatory	1.000	.709
E2_5Compo_tariff	1.000	.674
E2_7Nego_tariffs	1.000	.639
E2_8Adhere_publi_tariffs	1.000	.555
E2_9Lumpsum_fee	1.000	.648
E3_2Adj_tariff_P_LKc	1.000	.477
E3_4Revis_strat_plan	1.000	.547
E3_5Revis_compet_posi	1.000	.646
E4_3Comm_Plan_Dept	1.000	.502

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.878	27.698	27.698	3.878	27.698	27.698	3.181	22.718	22.718
2	2.384	17.027	44.725	2.384	17.027	44.725	2.087	14.907	37.625
3	1.592	11.373	56.098	1.592	11.373	56.098	1.924	13.743	51.368
4	1.235	8.824	64.922	1.235	8.824	64.922	1.898	13.554	64.922
5	.921	6.578	71.500						
6	.753	5.377	76.877						
7	.699	4.990	81.867						
8	.640	4.575	86.442						
9	.514	3.672	90.113						
10	.424	3.029	93.142						
11	.359	2.564	95.706						
12	.277	1.981	97.688						
13	.192	1.372	99.060						
14	.132	.940	100.000						

Extraction Method: Principal Component Analysis.

Component Matrix[a]

	Component			
	1	2	3	4
E2_1Policy_design_revi	.694	-.246	-.398	-.221
E3_5Revis_compet_posi	.673	-.414	.028	.144
E4_3Comm_Plan_Dept	.627	-.311	-.110	.004
E2_2Policy_rebates	.621	-.393	.035	.087
E3_4Revis_strat_plan	.609	-.269	-.315	.064
E3_2Adj_tariff_P_LKc	.467	-.385	.022	.331
E1_5Feedback_operators	.435	.657	.192	.441
E1_4Feedback_users	.366	.638	.023	.585
E1_3Appr_gov_revi	.367	.545	-.254	-.403
E2_4Tariffs_regulatory	.491	.506	-.219	-.404
E2_5Compo_tariff	.453	-.130	.608	-.286
E2_7Nego_tariffs	.559	.023	.570	-.031
E2_8Adhere_publi_tariffs	.401	.358	-.510	.073
E2_9Lumpsum_fee	.443	.377	.463	-.308

Extraction Method: Principal Component Analysis.
a. 4 components extracted.

Rotated Component Matrix[a]

Items	Factors			
	Tariff Policy	Tariff Regulation	Transparency	Stakeholder participation
E3_5Revis_compet_posi	.772	-.052	.213	.051
E2_1Policy_design_revi	.723	.454	.000	-.147
E2_2Policy_rebates	.707	-.033	.219	.008
E3_4Revis_strat_plan	.706	.207	-.065	.029
E4_3Comm_Plan_Dept	.684	.128	.134	-.015
E3_2Adj_tariff_P_LKc	.635	-.222	.063	.144
E2_4Tariffs_regulatory	.067	.806	.190	.139
E1_3Appr_gov_revi	-.042	.793	.113	.123
E2_8Adhere_publi_tariffs	.242	.556	-.267	.339
E2_5Compo_tariff	.223	-.015	.785	-.093
E2_7Nego_tariffs	.277	-.013	.719	.213
E2_9Lumpsum_fee	-.039	.341	.704	.184
E1_4Feedback_users	.032	.159	.014	.926
E1_5Feedback_operators	.007	.199	.236	.870

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 6 iterations.

Component Transformation Matrix

Component	1	2	3	4
1	.769	.401	.402	.293
2	-.561	.551	.077	.613
3	-.236	-.469	.845	.100
4	.195	-.562	-.344	.727

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

APPENDIX XI: CFA SPSS OUTPUT (FINAL MODEL): FACTORS INFLUENTIAL TO INFRASTRUCTURE TARIFF SETTING PRACTICES

Analysis Summary

Date and Time

Date: Wednesday, 23 April 2014
Time: 10:49:43 AM

Title

Cfa e1-e4 model fit 4 n67 for efa: Wednesday, 23 April 2014 10:49 AM

Notes for Group (Group number 1)

The model is recursive.
Sample size = 67

Variable Summary (Group number 1)

Your model contains the following variables (Group number 1)

Observed, endogenous variables

E2_2Policy_rebates
E3_5Revis_compet_posi
E2_1Policy_design_revi
E1_5Feedback_operators
E1_4Feedback_users
E2_9Lumpsum_fee
E2_7Nego_tariffs
Unobserved, exogenous variables
Tariff_Policy
e2
e4
e5
Stakeholders
e7
e8
e11
Transparency
e13

Variable counts (Group number 1)

Number of variables in your model:	17
Number of observed variables:	7
Number of unobserved variables:	10
Number of exogenous variables:	10
Number of endogenous variables:	7

Notes for Model (Default model)

Computation of degrees of freedom (Default model)

Number of distinct sample moments:	28
Number of distinct parameters to be estimated:	16
Degrees of freedom (28 - 16):	12

Result (Default model)

Minimum was achieved
Chi-square = 10.010
Degrees of freedom = 12
Probability level = .615
Estimates (Group number 1 - Default model)
Scalar Estimates (Group number 1 - Default model)
Maximum Likelihood Estimates

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
E2_2Policy_rebates	<---	Tariff_Policy	1.000				
E3_5Revis_compet_posi	<---	Tariff_Policy	1.004	.219	4.576	***	par_1
E2_1Policy_design_revi	<---	Tariff_Policy	.783	.186	4.219	***	par_2
E1_5Feedback_operators	<---	Stakeholders	1.000				
E1_4Feedback_users	<---	Stakeholders	1.000				
E2_7Nego_tariffs	<---	Transparency	1.675	.727	2.304	.021	par_3
E2_9Lumpsum_fee	<---	Transparency	1.000				

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
E2_2Policy_rebates	<---	Tariff_Policy	.717
E3_5Revis_compet_posi	<---	Tariff_Policy	.896
E2_1Policy_design_revi	<---	Tariff_Policy	.573
E1_5Feedback_operators	<---	Stakeholders	.849
E1_4Feedback_users	<---	Stakeholders	.911
E2_7Nego_tariffs	<---	Transparency	.746
E2_9Lumpsum_fee	<---	Transparency	.578

Covariances: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
Tariff_Policy	<-->	Stakeholders	.512	.685	.747	.455	par_4
Tariff_Policy	<-->	Transparency	.995	.572	1.739	.082	par_5
Stakeholders	<-->	Transparency	1.086	.602	1.804	.071	par_6

Correlations: (Group number 1 - Default model)

			Estimate
Tariff_Policy	<-->	Stakeholders	.108
Tariff_Policy	<-->	Transparency	.383
Stakeholders	<-->	Transparency	.371

Variances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Tariff_Policy	4.227	1.472	2.872	.004	par_7
Stakeholders	5.350	1.076	4.973	***	par_8
Transparency	1.600	.907	1.764	.078	par_9
e2	4.006	1.042	3.845	***	par_10
e4	1.050	.792	1.326	.185	par_11
e5	5.308	1.048	5.064	***	par_12
e7	2.076	.632	3.282	.001	par_13
e8	1.100	.553	1.988	.047	par_14
e11	3.192	.863	3.700	***	par_15
e13	3.580	1.953	1.833	.067	par_16

Matrices (Group number 1 - Default model)

Residual Covariances (Group number 1 - Default model)

	E2_7Nego_tariffs	E2_9Lumpsum_fee	E1_4Feedback_users	E1_5Feedback_operators	E2_1Policy_design_revi	E3_5Revis_compet_posi	E2_2Policy_rebates
E2_7Nego_tariffs	.000						
E2_9Lumpsum_fee	.000	.000					
E1_4Feedback_users	-.815	.331	-.214				
E1_5Feedback_operators	.614	.755	.095	.405			
E2_1Policy_design_revi	.200	-.228	-.234	-.473	.000		
E3_5Revis_compet_posi	.228	-.484	.134	.071	.025	.000	
E2_2Policy_rebates	.526	-.277	-.243	-.244	-.097	.001	.000

Standardized Residual Covariances (Group number 1 - Default model)

	E2_7Nego_tariffs	E2_9Lumpsum_fee	E1_4Feedback_users	E1_5Feedback_operators	E2_1Policy_design_revi	E3_5Revis_compet_posi	E2_2Policy_rebates
E2_7Nego_tariffs	.000						
E2_9Lumpsum_fee	.000	.000					
E1_4Feedback_users	-.890	.474	-.191				
E1_5Feedback_operators	.628	1.012	.088	.313			
E2_1Policy_design_revi	.200	-.299	-.266	-.500	.000		
E3_5Revis_compet_posi	.274	-.765	.186	.092	.027	.000	
E2_2Policy_rebates	.514	-.353	-.271	-.253	-.091	.001	.000

Factor Score Weights (Group number 1 - Default model)

	E2_7Nego_tariffs	E2_9Lumpsum_fee	E1_4Feedback_users	E1_5Feedback_operators	E2_1Policy_design_revi	E3_5Revis_compet_posi	E2_2Policy_rebates
Transparency	.246	.165	.045	.024	.009	.056	.015
Stakeholders	.023	.016	.570	.302	.000	.002	.000
Tariff_Policy	.027	.018	.002	.001	.093	.603	.157

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	16	10.010	12	.615	.834
Saturated model	28	.000	0		
Independence model	7	151.899	21	.000	7.233

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.333	.961	.909	.412
Saturated model	.000	1.000		
Independence model	1.903	.619	.493	.465

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.934	.885	1.014	1.027	1.000
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.571	.534	.571
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

NCP

Model	NCP	LO 90	HI 90
Default model	.000	.000	9.170
Saturated model	.000	.000	.000
Independence model	130.899	95.457	173.829

FMIN

Model	FMIN	F0	LO 90	HI 90
Default model	.152	.000	.000	.139
Saturated model	.000	.000	.000	.000
Independence model	2.301	1.983	1.446	2.634

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.000	.000	.108	.740
Independence model	.307	.262	.354	.000

AIC

Model	AIC	BCC	BIC	CAIC
Default model	42.010	46.424	77.285	93.285
Saturated model	56.000	63.724	117.731	145.731
Independence model	165.899	167.830	181.332	188.332

ECVI

Model	ECVI	LO 90	HI 90	MECVI
Default model	.637	.667	.806	.703
Saturated model	.848	.848	.848	.966
Independence model	2.514	1.977	3.164	2.543

HOELTER

Model	HOELTER .05	HOELTER .01
Default model	139	173
Independence model	15	17

APPENDIX XII: PUBLICATIONS

1. Bandara, Y. M., Nguyen, H.-O. & Chen, S.-L. 2013, *'Determinants of Port Infrastructure Pricing*', The Asian Journal of Shipping and Logistics, vol. 29, no. 2, pp. 187-206. doi: http://dx.doi.org/10.1016/j.ajsl.2013.08.004

2. Bandara, Y. M., Nguyen, H. O. & Chen, S.-L. 2014, *Influential factors in the design of port infrastructure tariffs',* (Under review in Maritime Policy & Management).

3. Bandara, Y. M., Nguyen, H. O. & Chen, S.-L. 2014, '*Influential Factors in Port Infrastructure Tariff Formulation, Implementation and Revision*, (Under review in Transportation Research Part A: Policy and Practice).

4. Bandara, Y. M. & Nguyen, H. O. 2014, *'Port Infrastructure Pricing Policy and Practice: A Case Study of Australia and New Zealand Seaports'*, (accepted with minor changes in Australian Journal of Maritime and Ocean Affairs).

5. Bandara, Y. M. & Nguyen, H. O. 2014, *'Port Infrastructure Pricing Policy and Practice: A Case Study of Australia and New Zealand Seaports'*, Proceedings of the International Association of Maritime Economists Conference, Norfolk, USA.

6. Bandara, Y. M., Nguyen, H. O. & Chen, S.-L. 2014, *'Port Infrastructure Pricing: Findings from a Survey of International Seaports'*, Proceedings of the International Association of Maritime Economists Conference, Norfolk, USA.

APPENDIX XIII: Port Name List – Regression analysis

Port Region	Country	Port Name
African	Kenya	Mombosa
	Liberia	Monrovia
	Mauritius	Port Louis
	Namibia	Walvis Bay
	South Africa	Durban
	South Africa	Cape Town
	South Africa	Saldanha Bay
	South Africa	Richads Bay
	Sudan	Port Sudan
	Tanzania	Dar es Salaam
Australasian	Australia	Adelaide
	Australia	Albany
	Australia	Broom
	Australia	Darwin
	Australia	Townsville
	Australia	Lucinda
	Fiji	Suva
	New Zealand	Taranaki
	New Zealand	Auckland
	New Zealand	Nelson
	New Zealand	Timaru
	New Zealand	Bluff
	New Zealand	Lyttelton
	New Zealand	Northport
East Asian	Brunai	Muara
	China	Shanghai
	Indonesia	Tanjung Priok
	Indonesia	Tanjung Perak
	Japan	Yokohama
	Japan	Tokyo
	Japan	Hakata
	Japan	Nagoya
	Japan	Osaka
	Pilliphines	Manila
	S.Korea	Busan
	S.Korea	Incheon
	Singapore	Singapore
	Taiwan	Kaohsiung
	Taiwan	Keelung
	Taiwan	Taichung
	Thailand	Laem Chabang
	Thailand	Bangkok
	Vietnam	Ho Chin Minh

Port Region	Country	Port Name
North and Western European	Belgium	Ghent
	Denmark	Aarhus
	Denmark	Fredrikshavn
	Estonia	Paldiski(north)
	Estonia	Tallinn
	Germany	Hamburg
	Germany	Bremerheven
	Holland	Vlissingen
	Lativia	Freeport Riga
	Norway	Bergen
	Poland	Gdansk
	Poland	Gdynia
	Poland	Swinoujscie
	Russia	St.Petersburg
	Spain	Valencia
	Spain	Bilbao
	Spain	Pasajes
	Spain	Santander
	Spain	Coruna
	Spain	Gijon
	Spain	Castellon
	Spain	Cadiz bay
	Spain	Aviles
	Spain	Alicante
	UK	Felixtowe
	UK	Southampton
	UK	Liverpool
	UK	Portsmouth
	Irland	Foynes
	UK	Lerwick
	UK	Scalloway
	UK	Grimsby
	UK	Immingham
	UK	Sheerness
	UK	Medway-Chatham
	UK	Belfast
	UK	Tyne
	Germany	Wilhelmshaven
	Latvia	Ventspils
	Latvia	Salacgriva
	Latvia	Liepaja
	Germany	Wismar
	Norway	Oslo

	Vietnam	Saigon	Norway	Harstad
	Myanmar	Yangon	Norway	Borg Havn
	Cambodia	Kompong som	Norway	Egersund
	China	Qingdao	Norway	Hammerfest
	China	Dalian	Norway	Kristiansandhavn
	Cambodia	Phnom Penh	Norway	Stavanger
Latin American	Costa Rica	Limon-Moin	Norway	Drammenhavn
	Ecuador	Guayaquil	Portugal	Setubal
	Argentina	Bahia Blanca	Iceland	Reykjavik
Carribbean & Central American	Trinidad	Port Spain		
	Puerto Rico	San Juan		
Medeteranian	Algeria	Skikda		
	Spain	Barcelona		
	Turkey	Ambarli		
	Greece	Thessaloniki		
	Spain	Tarragona		
	Cyprus	Limassol		
	Bulgaria	Varna		
	Bulgaria	Bourgas		
North American	Canada	Montreal		
	Canada	Halifax		
	Canada	Hamilton		
	Canada	St John		
	Canada	Trois-Rivieres		
	Canada	Saint John		
	Canada	Belledune		
	Mexico	Lazaro Cardenas		
	Canada	Sept-iles		